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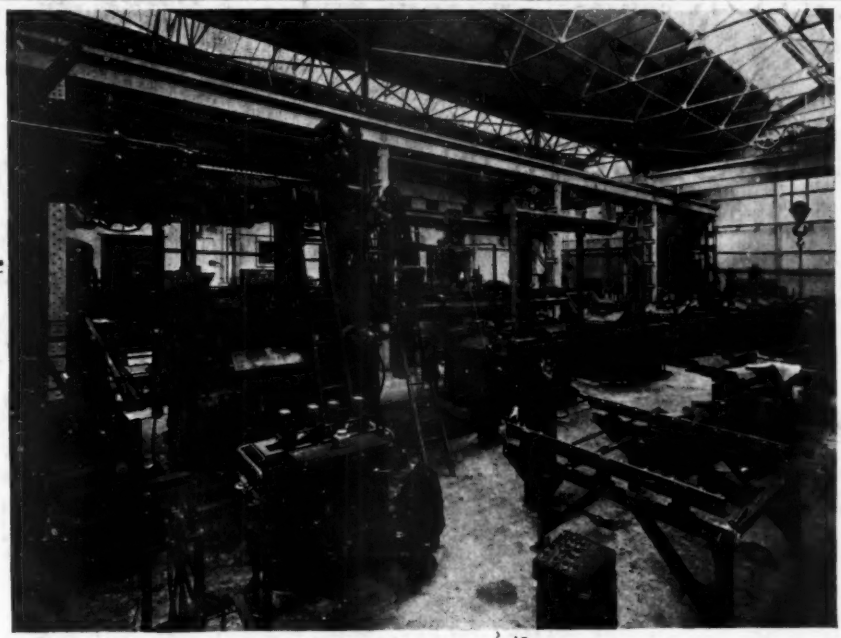

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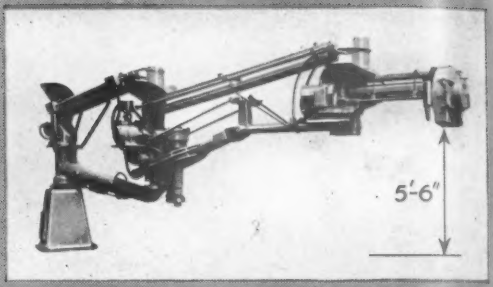

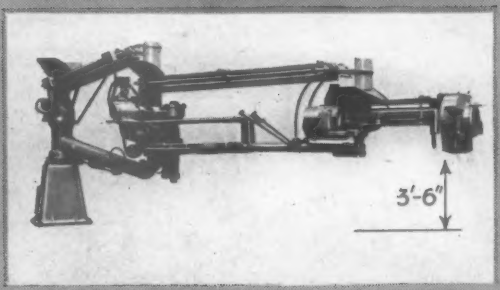

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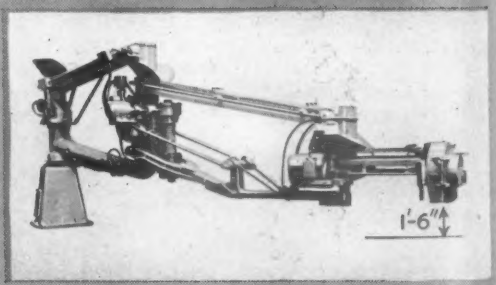

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Norway*

There are about 100 grey-iron foundries in Norway; a handful devoted to steel casting, and a large number of non-ferrous foundries, many of the latter being quite small. The quality of the castings the writer has seen is of a high order. The foundries which he has visited were well built, nicely warmed—for spring had not yet arrived—and excellently ventilated. This is an essential as the climate, during the winter, is such that it would be impossible to work in any building but one from which the entry of cold air is excluded. A rider to this last statement is the obvious inference that fume extraction assumes great importance. Norwegian foundrymen are assiduous readers of the English, American, German, and Swedish technical magazines and are fully cognizant of all the latest developments. Being a small country, with fewer than 4,000,000 inhabitants, there is not a great quantity of mass-production undertaken and such processes as shell moulding make no great appeal. However, there is a good deal of interest being shown in the CO_2 Process, and the applications of this are expected to increase.

The market in Norway for British foundry plant and machinery is good, but prices must be competitive with those from the continent of Europe. So far as supplies are concerned, it was learned that Danish foundry sand has replaced Erith, but it has to be used with a modicum of bentonite. Supplies of non-ferrous foundry fluxes and similar materials of British origin are increasing, owing to an enlightened sales policy. As the main fuels are wood and electricity, there is but a small market in the foundries for apparatus fired by town's gas, or for that matter, in the homes of the people.

The market for British cooking and space-heating stoves, except perhaps for those using electricity, is not good. Gas appliances modified to burn propane, or other easily liquified gas, would seem to have but a limited market, that being for use in caravans and yachts, as the villages are well supplied with cheap electric current, whilst the isolated farms have available excellent nationally-made wood-burning stoves. A highly competitive market exists for ironmongery and hardware, which is worth examining by UK manufacturers. Despite the smallness of the farms, co-operative buying and communal use makes the sale of tractors and other implements interesting. British-made motor-cars form a reasonable percentage of the cars one sees on the road, but Russian cars are entering the market on a barter system. Few British lorries and motor coaches are to be found. The writer's very pleasant visit to Norway was excellently organized by members of the local foundry organization to whom warm thanks are due.

* The Editor is at present engaged on a tour of Scandinavian foundries.

"Mutual Aid" and EPA

The European Productivity Agency was set up by the Organization for European Economic Co-operation in 1953, to develop and promote the most suitable and effective methods for increasing efficiency in all the sectors of the economic life of the member countries. As from July 1, member countries in Europe will be finding most of the funds and the United Kingdom has promised to provide £150,000 a year for three years as its share.

The Agency deals rather with the central organization concerned with productivity in each country. Thus the Agency looks to the Board of Trade (I.M.2 Division) to arrange for United Kingdom participation. Other Government departments, such as the Department of Scientific and Industrial Research and the Ministry of Education, are now advised and helped in these matters by a committee of industrial organizations which includes representatives of the Federation of British Industries; the National Union of Manufacturers and the Association of British Chambers of Commerce; of the British Employers' Confederation and the Trades Union Congress; and the British Productivity Council. It is hoped that as a result of these arrangements this country will play a full part in the Agency's work, and derive benefit from it.

Programmes

The Agency works to an annual programme. The fields at present covered are:

I. MANAGEMENT IN INDUSTRY AND COMMERCE: (*a*) education and (*b*) dissemination of techniques.

II. SOCIAL FACTORS: (*a*) human factors affecting efficiency, etc., and (*b*) trade union programmes.

III. TECHNOLOGY AND APPLIED RESEARCH: (*a*) encouraging interest in technology development and (*b*) serving as a clearing house for technical information.

IV. WORK ON PARTICULAR INDUSTRIAL SECTORS.

V. AGRICULTURE AND FOOD.

VI. ECONOMIC FACTORS: (*a*) advisory services on productivity measurement, and (*b*) study of general economic conditions hindering increased productivity.

VII. MARKETING AND DISTRIBUTION TECHNIQUES.

VIII. SPECIAL PROGRAMME FOR THE LESS-DEVELOPED AREAS OF EUROPE.

Future UK Participation

UK industrial and technical circles, it is stated, have already benefited from the Agency's work, but could get more out of it. Since the Agency provides for industry, in various European countries, to co-operate in efforts to increase productivity, there will be growing scope and need for such a common approach to common problems when, as is hoped, the present discussions about the European Free Trade Area bear fruit. There could be greater participation, for instance, in the projects already in hand.

Participation does, however, involve some expenditure. For example, if members of the staff of a firm, trade or professional association, or college, attend a conference, there may be a conference fee, and there will also be travelling expenses if the conference is held outside this country. Again participation in seminars within the United States may be borne by the Agency.

The United Kingdom might also take a bigger part in the work of the Agency by suggesting new projects. There must be many cases in which it would be useful to a section of industry if they could meet the people facing similar problems overseas, could attend an international course or could have the services of a consultant to suggest ways of tackling a problem. Professional and trade associations, educational bodies and other organizations which have suggestions of this kind, are invited to get into touch with I.M.2 Division, Board of Trade, or another Government Department concerned, or with one of the bodies represented on the Board of Trade Committee on European Productivity matters. They should indicate the extent to which they would be interested in participating (*e.g.*, by attendance at a suggested conference, by financing or underwriting the cost of seminars, etc.), if the United Kingdom put forward their proposal and the Agency accepted it. The Board of Trade would be glad to put forward projects which seem likely to encourage increased efficiency and in which organizations in this country would be prepared to participate.

CFA Costing Conference

The Council of Ironfoundry Associations, have made arrangements for a one-day study conference on "Foundry Costing and Estimating" to be held at the Connaught Rooms, London, W.C.2, on Thursday, June 27. This conference will provide an opportunity for representatives of firms in the foundry industry to review their present practice in relation to the broad purposes of cost accounting and methods of costing and estimating. The fee will be three guineas per delegate, inclusive of morning coffee, luncheon and tea.

Programme

The conference will be under the chairmanship of Mr. H. A. Bonney, F.C.I.S., managing director of Follsain-Wycliffe Foundries, Limited. The proceedings will be conducted by Mr. W. E. Harrison, F.C.W.A., A.M.I.I.A., past-president of the Institute of Cost and Works Accountants, supported by Mr. G. B. Judd, F.C.A., of Mann, Judd & Company, and Mr. H. P. Court, F.C.W.A. The programme includes: 9.30 a.m. chairman's introduction followed by "The Need for Costing," by Mr. G. B. Judd; at 11 a.m. "Cost Ascertainment—the Accounting Aspects," by Mr. W. E. Harrison and at 12 noon discussion of the two previous papers.

At 2 p.m. after luncheon there will be "Detailed Considerations of Cost Ascertainment," by Mr. H. P. Court; at 3 p.m. "Estimating," by Mr. W. E. Harrison and from 4.15 to 4.45 p.m. further discussion.

Delegates wishing to attend should reserve places by application to the Training Officer, Council of Ironfoundry Associations, 14 Pall Mall, London, S.W.1, and make their own arrangements for accommodation in London if required. They are advised to book early.

Correspondence

IRON BRIDGE ANALYSIS

To the Editor of the FOUNDRY TRADE JOURNAL.

SIR,—In your issue of May 2, Mr. R. S. Darby gives the analytical results obtained on a sample of metal from the Iron Bridge in Shropshire.* I have recently analysed a piece of pig-iron from the Coalbrookdale Company bearing the inscription "Abraham Darby 1756." The results obtained were:—Total Carbon 3.25; Silicon 1.16; Manganese 0.97; Sulphur 0.068, and Phosphorus 0.70 per cent.—Yours, etc.

W. ARCHER.
Chief Chemist.

Allied Ironfounders, Limited,
Wellington, Shropshire.
May 14, 1957.

[* The analysis quoted by Mr. Darby for the bridge was:—T.C. 3.71, Si 1.45, Mn 1.11, S 0.062 and P 0.48.—EDITOR.]

Progress in the Continuous Casting of Tin Bronzes*

By E. C. Ellwood, B.Sc., Ph.D., F.I.M., M.I.M.M.

Dr. Ellwood is chief metallurgist of the Tin Research Institute. In November, 1939, he joined the British Aluminium Company and in 1945, he was appointed lecturer in metallurgy at King's College, University of Durham. Dr. Ellwood took up his present appointment in 1953; he has been author or co-author of some 20 papers on a wide range of metallurgical subjects.

The history and development of the process of vertical-continuous casting are outlined in this comprehensive survey, that will be of considerable interest to founders generally. The Paper continues by describing in detail, a number of processes that are in operation in different countries. The development of equipment by the Author at the Tin Research Institute is dealt with fully, and some of the drawbacks encountered when casting bars for subsequent rolling are detailed together with the cures that were effected. In concluding his paper, Dr. Ellwood states that considerable progress has been registered in recent times; the rolling quality of the product is high, but that the researches described only form a basis for much further work.

For industrial applications, two distinct types of bronze are required as new material for engineering components. In the first group, much bronze is used in the cast condition for machining to bushes, gears and specialized shapes. By far the greatest footage is for bushes which are made from small-diameter rods and tubes. Large-diameter bushes are also produced but, generally speaking, these are required in small quantities and are conveniently made from chill or centrifugally-cast material. It is interesting to note that the American Smelting and Refining Company are now continuously-casting rods and tubes up to 9-in. dia. In the second group, continuously-cast bronze provides excellent stock for working to wire, sections, strip or even tubes. Bronzes of lower-tin content can be hot worked satisfactorily, when prepared from pure materials, but they are more commonly cold worked. The great advantage offered by continuous casting is the provision of a cast stock of excellent quality in thicknesses much closer to the finished size than can be produced by any other form of casting. At the same time, comparatively thin-section material can be obtained in sufficient length so that the unit weights for processing are higher than those produced from static casting, thus aiding more economic rolling and drawing operations. Coupled with these advantages are the excellent quality and uniformity of continuously-cast bronze.

It would appear almost certain that continuous casting will replace chill casting for a great deal of bearing and gear bronzes and for the production of wrought bronzes with the possible exception of large bushes or gears and wide bronze sheet or strip.

EXISTING PROCESSES AND THEIR DEVELOPMENT

"Closed" Method

The basic ideas, upon which almost all recent developments are based, are contained in Eldred's Patent[1]. In this, Eldred proposed the use of the "closed" method of casting and the use of water-cooled dense graphite for the die (Fig. 1). The essential feature of the "closed" method of casting is that liquid metal in the die forms a continuum with that in a receptacle, of greater diameter than the rod being cast, thus avoiding the necessity of pouring metal directly into the die. In 1936, in a second Patent, Eldred described the method of making tubes using a tapered graphite mandrel in a graphite die (Fig. 2). Later, the American Smelting and Refining Company (Asarco) took over Eldred's patents and combined them with some of their own; rapid progress was then made in the development of the process, this is shown in Fig. 3, a diagrammatic sketch of their process. While embodying the essentials of the original Eldred Patents (*i.e.* "closed" method of casting and the water-cooled graphite die), additional features are included. Among these are the provision of baffles and an inert atmosphere in the furnace feeding the dies, the former to prevent non-metallic inclusions entering the casting and the latter to prevent oxidation. In addition, the plant is equipped with a "flying" cut-off saw and equipment for handling and straightening the cast products. In addition to casting rods and tubes up to 9-in. dia. in a number of tin bronzes, Asarco also produce sections which, in some cases, approach extrusions in complexity. Multiple casting is also practised. The Asarco

* Paper presented in Germany to a conference organized in Dusseldorf by the local Tin Information Bureau and subsequently printed in *Giesserei*.

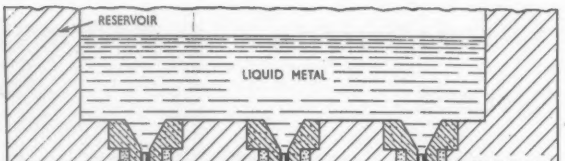

FIG. 1.—*Diagram of the casting head of the "closed" method of continuous casting patented by Eldred in* 1932. *The dies used in this method are made of a dense graphite and are water cooled.*

plant has been in operation since 1947[3], producing bronze of very high quality, and has recently been extended.

"Open" Method

In 1949 Pell-Walpole and Kondic[4] published an account of experiments carried out at the University of Birmingham on the continuous casting of bronze by the open method. They used a die of chromium copper which was fed from a tundish device having a hole of such a diameter as to allow the flow of sufficient metal to maintain the level in the die in conjunction with a chosen rate of withdrawal. The tundish (which was heated before casting), was not heated during running and the liquid metal introduced to the tundish had insufficient heat content to prevent freezing. This difficulty could obviously be overcome. The open casting of bronze presents some difficulties with surface finish and also difficulties in pouring and controlling the rate of flow for small-diameter rods and thin-wall tubes. On the other hand, bronze so cast in water-cooled metal dies has higher tensile strength and smaller grain size than that produced in graphite dies. However, the advantage of not having to control pouring when the "closed" method of casting is employed appears to outweigh all other considerations when small sizes are required. Unfortunately, there is little prospect, at present, of adapting the "closed" process for water-cooled metal dies on account of the difficulty of preventing liquid bronze wetting and attacking such dies at the high temperature required for a true closed operation. Experiments at the Tin Research Institute, using a graphite sleeve between a water-cooled metal die and the tundish, indicate that so long as solidification occurs above the metal section, the structure and properties are typical of those obtained in graphite dies and, as soon as the solidification zone is brought down to the metal section, wetting and ultimately welding occur.

When dealing with relatively large sizes of round billets for extrusion or rectangular slabs for rolling, the original Junghans process (Fig. 4), is very satisfactory and produces perfectly sound material. The surface quality with bronze, however, is not as good as that obtained on brass or deoxidized copper, and bronze cast in this way usually requires "scalping" at some stage of manufacture. It has been reported that experiments are being made in Germany on the adaptation of the Junghans process for the production of rods down to 25 mm. dia. and tubes with wall thicknesses down to 20 mm.

Sheepbridge Alloy Castings[5] have developed a method of continuously casting bronze and cast-iron. Their process uses a rather long horizontal graphite die and intermittent withdrawal after the manner proposed by Jacquet[6]. The casting speeds attained are 40-ft. per hr. of 3-in. dia. bar to 160-ft. per hr. of 1¼-in. dia. bar. No mention has been made of the production of tubes. The bars are supplied in the machined condition to within 0.002 in. of the specified diameter. Typical properties of a bar made to B.S.S. 1400 PB.I. (10 per cent. Sn.; 0.5 per cent. P.) are quoted as follow: Ultimate tensile strength 18 to 22 tons per sq. in.; elongation 4 to 10 per cent. and Brinell hardness 105 to 127.

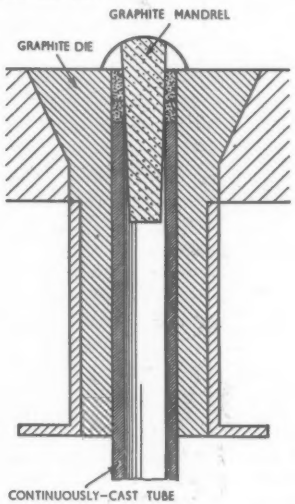

FIG. 2.—*Cross-section of the tapered mandrel and die, designed by Eldred in* 1936, *for the production of continuously-cast tubes.*

FURTHER DEVELOPMENTS

Experiments in the Tin Research Institute on the semi-continuous casting of small-diameter rods and tubes have been described recently[7] and it is not proposed to discuss the contents of this paper here. However, some additional information has become

available since the work described was finished. In the first place, a certain amount of practical experience has been obtained in works in which such plants have been operated. It has been found that the speed of casting of up to 30-in. per min. can be realized, this is considerably in excess of that obtained in the laboratory. Under production conditions, however, such high speeds are not used since it is preferable to reduce the risk of breakage of the rod by running more slowly. Nevertheless, production at rates faster than was possible in the laboratory are still practicable. It has also been found that the type of graphite is not so critical as was once thought, good results having been obtained with soft common graphites. Die "life" is variable, but long enough to render die costs to be comparatively insignificant. No comparative figures are available but it has been suggested that die costs per unit weight of bronze cast compare favourably with the cost of purchasing and maintaining moulds for chill casting.

Tin "Sweat"

The problems of tin "sweat" have not yet been solved completely but the incidence of tin sweat is somewhat less than appeared likely from the laboratory experiments and it has been reported, independently from three separate sources, that the tin-sweat rings which build up in the die can be detached by slowing or stopping the machine for a short time and re-starting. This experience is somewhat similar to that obtained in the Author's own experiments, except that it was found that the rod stopped involuntarily when the tin sweat built up to a critical thickness and then started to move again when it had cooled and contracted sufficiently to loosen the tin sweat ring from the graphite.

Horizontal Casting

Many who have seen the laboratory plant have expressed the opinion that the machine would be much more convenient if it was arranged so that the rod emerged horizontally instead of vertically. It is agreed that this has engineering advantages because the vertical height required is very much less, thus avoiding the necessity of having a high roof or sinking a pit. However, from a metallurgical point of view the vertical arrangement is preferred because this allows any gas released on solidification to rise freely in the molten metal and escape instead of being trapped along the top of the bore of a horizontal die. Further, the bar might bear more heavily on the bottom of the die and thus cool more rapidly at the bottom than the top. These points have not been put to experimental test at the Tin Research Institute but are mentioned because they have been raised so often by practical founders.

Temperature Gradients

It has been suggested that when the pasty metal zone reaches a critical length, frictional forces between the partially solid metal and the graphite die cause the rod to break; certain practical implications follow from this. One is that the temperature gradients in the solidifying metal should be as steep as possible to reduce the length of the pasty zone. To achieve this end it has been found beneficial to heat the top of the die directly by the gas burner in the tundish-type of heating furnace. The original arrangement is shown in Fig. 5, but in later modifications the bottom has been removed from the furnace and the gas burner lowered so that the top of the die and the bottom of the tundish are heated directly. The temperature gradient is also affected by the heat-transfer between the graphite and the inner brass sleeve in the water jacket. Experience has shown that the brass sleeve distorts in use so that it makes contact at the ends of the die only. This reduces the cooling rate in the centre of the die and must be corrected by re-machining the bore of the water jacket from time to time.

Intermittent Withdrawal

As mentioned earlier, intermittent withdrawal

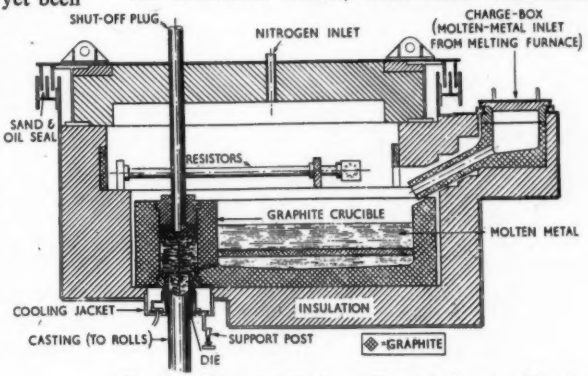

FIG. 3.—*Diagrammatic section of the combination of Eldred and American Smelting & Refining Company (Asarco) methods of continuous casting, embodying an inert atmosphere in the tundish.*

was described by Jacquet and is practised by Sheepbridge Alloy Castings, Limited. From a consideration of the effect of intermittent withdrawal on the shape of the solidification front, it appears likely that this method of withdrawal could be of distinct advantage when dealing with bronze such as 85/5/5/5, which in the author's experience is somewhat more difficult to cast continuously than the low-zinc gunmetals or straight tin-bronzes. During intermittent withdrawal, the solidification front has an opportunity to flatten during the "dwell" period. When the solidification front is practically flat the conditions are correct for withdrawal at a relatively high speed but as withdrawal continues, the lengthening of the pasty zone leads to conditions favouring fracture. The motion of the withdrawal rod is arrested at a point just short

of fracture and the solidification front allowed to flatten again in preparation for the next cycle. It appears likely that intermittent withdrawal will provide a means of extending the work on bronze to other non-ferrous alloys*. In passing, it must be mentioned that such a procedure is exactly similar to that adopted in the Junghans machine so far as the relative motion between the die and metal are concerned. In this process the mould travels down with the rod and returns at three times the speed, giving a ratio of period of dwell to period of relative motion of three to one.

Lubrication

Lubrication of the die is also relevant to the points made because friction between the die and rod is one of the factors limiting the alloys that can be cast and also the speed of casting. Experiments on die lubrication have been made using paraffin wax and beeswax. Such lubricants, when rubbed into the surface and gently warmed so that they soak into the graphite, are temporarily effective, but the lubricating effect soon disappears. This is to be expected because the surface-

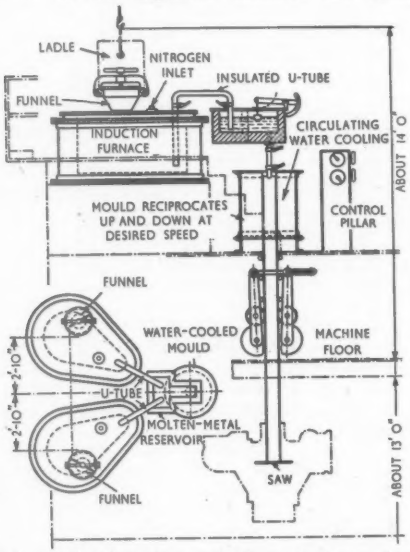

FIG. 4.—*Side elevation and plan of the equipment used in the original Junghan's process for producing castings of relatively large diameter or rectangular section.*

temperature of the die, in the solidification zone, is presumably in excess of the boiling point of such waxes. It is possible that the wax carbonizes when in contact with the hot bronze and carbon is deposited in the surface pores in the graphite.

* Since this manuscript was prepared, the American Smelting & Refining Company have been granted B.P. No. 760,154 which covers this type of process.

This may be advantageous quite apart from any initial lubricating effect.

Casting of Stock for Rolling

The aims in continuously-casting bronze bars for rolling are to produce stock with: (*a*) a good surface so that scalping can be avoided; (*b*) the least thickness possible, so that cold reduction can be carried out with the minimum number of passes and intermediate anneals (this is not so important with binary bronzes containing 5 per cent. of tin or less—which can be hot rolled without excessive edge cracking—but becomes increasingly important as the tin content is increased above 5 per cent., or when zinc is a constituent of the bronze); (*c*) unit weights at least as great as those of chill-cast slabs so that rolling efficiency is not reduced; (*d*) widths up to 350 mm., and (*e*) square corners to reduce the risk of edge cracking during rolling. Aims (*a*) and (*b*), in the Author's opinion, require the process to be of the "closed" type and all the experiments have been made with this system of casting. It cannot be claimed that these aims have been achieved but it may be of interest to describe the progress made.

Limitations

Narrow, rectangular stock for rolling can obviously be cast in graphite dies similar to those used for rods, provided that the die cavity is of

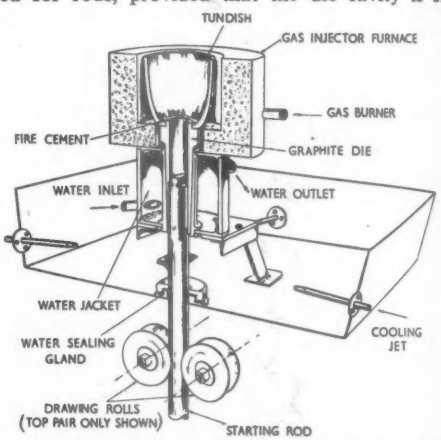

FIG. 5.—*Sectional sketch of the casting head designed by the Tin Research Institute for continuously-casting rods, using a tundish of relatively small capacity.*

the correct shape. The use of dies with circular cross-sections and corresponding water-jackets offer the great advantage that distortion of the water-jacket can be minimized by suitable design. Thus, contact between the graphite and water-jacket and hence cooling can be maintained. However, as the width of the cast strip increases, the circular die becomes less effective because the thickness of the graphite bounding the flats of the strip increases considerably with the result that heat

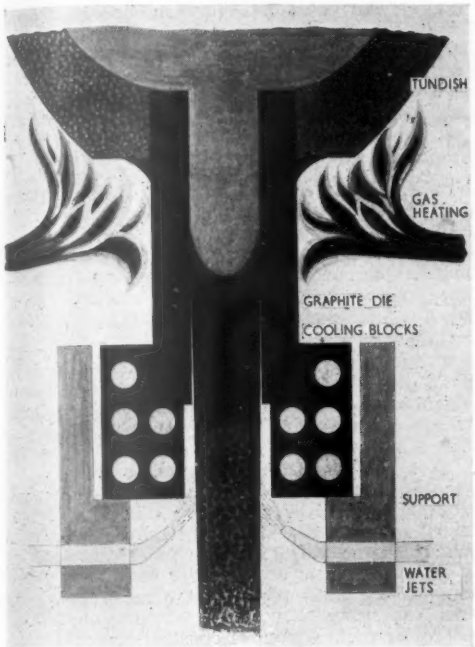

FIG. 6.—*Modification of the cooling system of the Tin Research Institute casting head, for continuously-casting wide slabs.*

transfer through the graphite becomes the factor limiting the cooling of the bronze.

Because it is desired ultimately to cast fairly wide slabs it was decided to try alternative arrangements for cooling the graphite die. Experiments were made using flat water-jackets held in contact with the graphite. These were unsuccessful because the inner faces of the water jackets quickly distorted when the die was filled with molten bronze, so that coolant contact over most of the area was lost. This gave inadequate cooling of the bronze and lead to hot-short fractures in the die.

An alternative method of cooling illustrated in Fig. 6 was then developed. This consisted of mounting the graphite die on two massive bronze blocks which are cooled by five water channels and arranged so that heat is conducted mainly from the bottom of the die although some is also removed from the sides. This method of cooling is sufficient to give a strong shell to the casting as it emerges from the die and final cooling is effected by water sprays below the cooling blocks. Under normal running conditions the top and bottom of the die are at about 1,100 and 450 deg. C. respectively.

Using this design of die, bronze sections of 3 by 1 in. and 3 by ½ in. have been cast in alloys containing 10, 5 and 3 per cent. tin and 2 per cent. zinc. This indicates that, in principle, the arrangement is satisfactory but it is appreciated that sections of greater width must be cast before the process is of any practical value. The casting speed achieved is about 5-in. per min., this also needs to be increased.

Withdrawal Mechanism

This machine withdraws the bronze from the die by means of a dummy bar attached to a platform which is moved by a pair of driven screws. The platform has a rise and fall of 11 ft.; this represents the maximum length that can be cast. Normally, the speed of the platform can be varied between 2½- and 15-in. per min. but the range may be altered to between 10- and 60-in. per min. by interchanging gears in the drive. This change in the method of extraction from the wheels used in the earlier machine, has no real significance other than the desire to experiment with a different withdrawal mechanism. The present arrangement has the advantage of being somewhat more robust than that used previously and it is also easier to change the size of the section being cast. On the other hand, the length that can be cast is limited to the length of the screws and some time is wasted in returning the platform to the top of the screws in preparation for the next cast.

Die Design

Split dies with a longitudinal joint have been used for the Author's experiments, however this is not desirable because the joints tend to open under the influence of the temperature gradients in the graphite. This feature can produce a fin on the rod which quickly damages the die. The same thermal stresses sometimes crack the die so that a strong graphite is required.

Most of the work has been carried out on dies with radiused corners. This is not wholly satisfactory because such sections lead to edge-cracking during cold rolling. This is not very serious and might be acceptable if it was not known that similar material with square corners can be rolled without edge-cracking. When experiments have been made with square-corner dies, difficulty has been experienced with fracturing of the bronze. It appears that the fracture starts at the sharp corners in the die and spreads across the section. More research is needed on the corner radius of the die to find the minimum radius for easy casting and to see if this radius is sufficiently small to avoid edge-cracking during rolling.

FIG. 7.—*Macrostructure of a continuously-cast slab of tin-bronze (etched* × 1*). The thin superficial layer of chill crystals can be seen together with the central columnar structure.*

Continuous Casting of Tin Bronzes

Structure

The macrostructure of bronze cast by the method described consists of a very thin surface layer of chill crystals around very large columnar grains as shown in Fig. 7. This structure might well cause anxiety to a rolling-mill metallurgist used to material of much finer grain, but it has been found that a 5 per cent. tin-bronze with this structure can be reduced by 60 per cent. without any anneal and can be further reduced to any reasonable practical thickness with suitable intermediate anneals. It also has been found that continuously-cast 5 per cent. tin-bronze can be hot rolled without any difficulty, when made from pure materials. However, the Research Institute has recently been interested in the rolling qualities

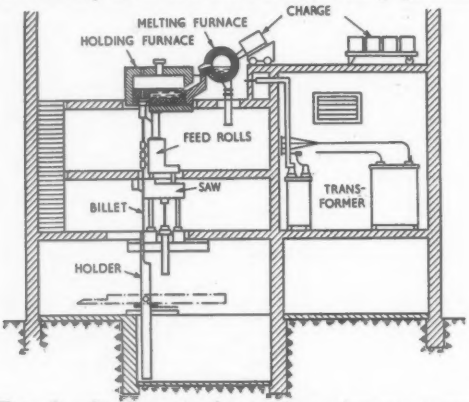

FIG. 8.—*Section of the modern Asarco process building and plant, indicating the position of the ancillary equipment required for continuous casting.*

of ternary bronzes containing up to 2 per cent. zinc with about 3 per cent. tin but find that they cannot be hot-rolled without cracking. The surface quality of the continuously-cast bronze is good and strip rolled from it without scalping or special surface finishing is of excellent quality.

In conclusion, it may be said that a method of casting narrow stock for rolling has been developed, but it must be admitted that what has been done so far cannot form more than a basis for further work. The rolling quality of the bronze cast is good and leaves no doubt that it is metallurgically satisfactory.

DISCUSSION

In the discussion which followed, G. SCHWIETZKE (Düsseldorf) pointed out that with reference to the Asarco process, perhaps it should be mentioned that the plant requires a building of extraordinary height, the four to five floors necessary for melting, holding, continuous casting, sawing, and a cellar require a building 26- to 33-ft. high (Fig. 8).

Under normal conditions the continuously-cast billet produced by vertical-casting arrangement is completely free from gas. On one occasion a continuously-cast leaded-gunmetal contained large hydrogen blisters; this was accidental and was caused by water or moisture from the holding furnace reaching the liquid metal.

Table 1 shows some remarkable mechanical properties obtained for continuously-cast 85/5/5/5 leaded gunmetal in comparison with sand-cast bars of the same metal from the same melt. In addition to the high figures obtained for continuously-cast gunmetal the uniformity of the values is noticeable. This experience indicated that the continuous casting of bronze requires constant supervision of the various working conditions, such as metal temperature in the holding furnace and at various positions of the die and the progressing billet. Furthermore the temperature of the die at its upper and lower end, the cooling-water temperature and the speed of casting seem to be important in order to keep the heat equilibrium between liquid metal and solidified casting constant whilst the production of the billet is in progress.

P. SPITALER referred to the experience that rectangular cross-sections with sharp corners can be rolled without cracks but that such sections have a tendency to cracking on the edges during continuous casting, this finally leads to the billets breaking off. On the other hand it has been found that billets with rounded corners can be continuously cast free from cracks, but that cracks develop on the edges during subsequent rolling. He asked whether this statement regarding crack-

TABLE I.—*Comparison of the Mechanical Properties of* 85/5/5/5 *Leaded Gunmetal Sand and Continuously-cast.*

Position of test-bar.	Rod dia.	SAND-CAST. Yield point, tons per sq. in.	Tensile strength, tons per sq. in.	Elongation, per cent.	Brinell hardness.	CONTINUOUSLY-CAST. Yield point, tons per sq. in.	Tensile strength, tons per sq. in.	Elongation, per cent.	Brinell hardness.
Centre part	1⅝ in.	6.2	11.3	15	64	9.9	19.9	21.6	90
Centre part	1⅜ in.	6.2	11.2	14.7	68	9.7	19.1	18.3	84
Outside	1⅝ in.	6.8	12.9	18.3	75	9.7	20.2	21.0	85
Outside	1⅜ in.	5.9	14.0	23.3	68	9.9	20.4	24.2	90
Centre part	1¼ in.	6.8	13.6	20.9	75	9.7	19.8	16.7	90
Average		6.4	12.6	18.4	70	9.8	19.8	20.4	88
Properties for BS 1400-LG2 ..		6.0	12.0	12.0					

ing was based on practical experience or could an explanation be offered?

DR. E. C. ELLWOOD (London) replied, that when corners were rounded, cracks are not present after casting. These only develop during rolling. In his opinion, when corners are radiused, rolling of the metal occurs, in the first instance, at the parallel surfaces; the metal can give way on the side surfaces without rolling pressure stress. As a consequence, the formation of cracks on the edges occurs on these surfaces. When using billets with sharp corners this is not the case because the whole section is here exposed to the rolling pressure.

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[4] W. J. Pell-Walpole and V. Kondic, *Metal Industry*, 1949, **74**, 203.
[5] *Engineer*, 1955, **199**, 777.
[6] M. V. M. Jacquet, Brit. Patent No. 540,276, 1941.
[7] E. C. Ellwood, J. C. Prytherch and E. F. Phelps, *Journal of the Institute of Metals*, 1955-56, **84**, 319.

Railway Contracts

Contracts in connection with the modernization plans for British Railways have been announced by the British Transport Commission. Metropolitan-Cammell Carriage & Wagon Company, Limited, Birmingham, is to supply 80 motor-cars and 80 driving-trailer cars, and Cravens, Limited, Sheffield, 48 motor-cars and 48 driving-trailer cars.

Other companies which have been awarded contracts are:—Drewry Car Company, Limited, London, E.C.2, 12 204-h.p. diesel-mechanical locomotives; Andrew Barclay Sons & Company, Limited, Kilmarnock, 16 diesel-mechanical locomotives; North British Locomotive Company, Limited, Glasgow, 25 200-h.p. diesel-hydraulic locomotives; Hunslet Engine Company, Limited, Leeds, 12 200-h.p. diesel-mechanical locomotives.

The Birmingham Railway Carriage & Wagon Company, Limited, will supply 16 20-ton ballast brake-vans with plough, and the Fairfield Shipbuilding & Engineering Company, Limited, Glasgow, have been awarded a contract for three 60-ton flat wagons.

City and Guilds Welding Conference

One hundred welding examiners of the City and Guilds of London Institutes attended a conference at Cricklewood last month, and discussed the general procedure which should be observed during practical examinations. The conference was held at British Oxygen Gases, Limited, and was presided over by Mr. Frank Clark, manager of the technical-service department, and chairman of the Institute's advisory committee on welding.

The local examiners, who attended from all parts of the country, heard talks on written and practical examinations by three chief examiners, Dr. W. D. Biggs, Mr. E. Ryalls and Mr. A. R. Moss, and discussed the various problems that arise in conducting and marking practical tests. (It will be remembered that at a recent conference of the British Steel Founders' Association, members were exhorted to make sure that those entrusted with weld repairs on castings were fully qualified for such work. The City and Guilds of London Institutes is constituted as an examining authority for all welding work.)

Sir JOSIAH ECCLES, who as deputy chairman (operations) of the Central Electricity Authority, will be responsible for the commissioning and operation of England's first commercial nuclear-power stations, last month saw the progress being made on the manufacture of parts for the Authority's Berkeley (Gloucestershire) nuclear station, which is being built by the AEI-John Thompson Nuclear Energy Company, Limited.

Fewer Unemployed

Improvement, both in the number unemployed and those working short-time in manufacturing industries, is recorded for April by the Ministry of Labour.

Unemployment continued to fall in late March and early April, and on April 15 there were 342,000 unemployed, 21,000 fewer than a month before, but 76,000 more than in April, 1956. The percentage of all workers unemployed in April was 1.6, compared with 1.7 in March and 1.2 in April last year. Those working short-time dropped by 27,000 to 82,000 in the last week in March, almost the same as a year ago.

Unfilled vacancies rose by 34,000 to 285,000, 45,000 more than at the beginning of February, but 106,000 fewer than a year ago. There was a slight shift of labour during March from manufacturing to basic industries and engineering lost 14,000. There were most unfilled vacancies in London and the south-east (78,000), but the largest increase during the month was in the Midlands where the unemployment rate has now dropped to 1.5 per cent., 0.1 below the national average.

London Airport Visit

A visit for London-area members of the Guild of Associates of the Birmingham College of Technology to the workshops of British Overseas Airways Corporation at London Airport has been arranged for Sunday, June 30. The trip will include a tour of the headquarters buildings and hangars, inspection of an aircraft (possibly a "Britannia"), a tour of approximately 8 miles around the airport, and tea in the airport restaurant; cost, including tea, will be £1 per head. The coach will leave Northumberland Avenue, London, W.C.2 (Trafalgar Square end) at 12.45 p.m. and return at about 7 p.m. (Members must travel on this coach as it will also be used for the airport tour.) All members and their ladies (or one guest) are invited to take part in this function; early application for places is advised as the party is limited to a maximum of 35. Applications should be sent to the honorary secretary, Mr. T. O. Young, A.R.I.C., at 32, Bramham Gardens, London, S.W.5.

Mr. W. D. PUGH, chairman of Firth Vickers Stainless Steels, Limited, opened the new 32-acre sports ground of the firm in Bawtry Road, Sheffield, on Saturday, May 11; 21 acres have already been developed and the ground, it is claimed, will eventually be one of the finest in Sheffield.

POCKETS OF INFLAMMABLE GAS, mostly methane, have been found by the British Petroleum Exploration Company at Trumfleet, near Doncaster, while searching for oil. The finds are believed to be of economic importance. The exploration company's oil well at Edgmonton, in Nottinghamshire, is producing 60 tons daily.

Equipment and Supplies

Conveyor Chain

In reply to requests for further information about the conveyor chain used in the continuous cupola-charging apparatus* designed and installed by International Combustion, Limited, in their Derby foundry, the following particulars have been furnished by Crescent-Webb, Limited, 138 Borough High Street, London, S.E.1., who supplied the chain.

This type of conveyor-chain was developed originally in the USA for use in coal mines and is still widely used there in mining operations, for the haulage of trucks or tubs, for the charging of coal bunkers and hoppers and for the powering of conveyors and elevators. The design feature whereby any link of a chain may be detached and a replacement fitted enables repairs and maintenance to be carried out in minimum time, at low expense and with the least interruption of production. So that the chain may have long "life" and a high factor of safety, it is drop-forged from EN8D steel and fully heat-treated. As the automobile manufacturing industry developed, and the need for mechanized handling aids to production became urgent, this type of chain was adopted in that industry and its use became widespread for many sorts of conveyors especially the overhead type. Flexibility of the chain in vertical and horizontal planes and, of course, in combinations thereof, makes it, it is claimed, especially versatile.

The chain is manufactured in four sizes—"348," "458," "468" and "678," the first figure—*i.e.*,—3, 4 or 6 indicating the pitch of the chain link. The "458" size is that by far the most widely used: the "468" was developed especially for use in foundries and in similar situations where highly abrasive conditions exist. In the USA, it is widely used not only in overhead conveyors, but also in cooling conveyors, mould conveyors sand and scrap conveyors.

Derby Installation

When International Combustion, Limited, were reviewing their methods of cupola charging they had in mind that what was needed was a system which would enable charges to be made up from a variety of pig-irons and scrap. The possibility of using a skip hoist or hoists fed by a travelling hopper/weigh-car was considered, but eventually it was decided that a continuously operating overhead conveyor system would provide the greatest flexibility and would afford the best economy in time and labour. The conveyor track consists of a number of bends some of them of comparatively small radius. The performance required of this conveyor is, therefore, especially arduous as it has to follow a difficult path, has to operate continuously and in conditions in which, despite all precautions taken by the firm to provide a clean atmosphere, some fouling of the conveyor by abrasive dust is inevitable. The chain used in this particular installation is the "678" type and, incidentally, it is the same size which has been selected by the Ford Motor Company, Limited, for the conveyor installations in their new foundry at Dagenham. In the Derby plant, so as to maintain the chain pull within recommended limits, the drive was provided by two Crescent-Webb "floating" caterpillar-drive units. The chain pull is then balanced automatically between these two units. The speed of the conveyor can be varied and in the event of an accident causing jamming, power is automatically switched off by operation of limit switches by the floating drives. Further safety devices in the form of "anti-runaway gear" and "anti-back-up gear" are incorporated as safeguards against chain breakage.

Disc Grinder

Of interest to founders is the information that Lorant & Company, Limited, of Croydon Road, London, S.E.20, have introduced a high-speed disc grinder, marketed under the trade name of "Suhner." This grinder (Fig. 1), together with the company's "Naxoflex" armoured discs, is claimed to be suitable for the rapid cutting of risers and feeder heads; removal of chilled casting skin, prior to machining; grinding irregularities; general cleaning and smoothing operations in a foundry. The grinder is fitted

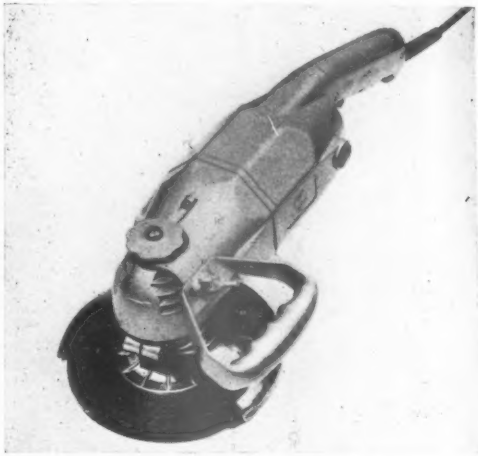

FIG. 1.—*High-speed hand-held grinder for use in foundries is now available to UK purchasers and is marketed by Lorant & Company, Limited, London, under the trade name of "Suhner." Protection is afforded by the steel wheel guard, and the unlimited adjustment of the front handle is claimed to prevent fatigue.*

with an efficient universal motor for 220 v. a.c. or d.c. supply, with a continuous output of 1.3 h.p. with temporary-overload capacity.

The solid die-cast housing is attractive and conveniently shaped; the inclined position of the rear grip and the universal adjustment of the front handle allow the hand tool to be adapted to the most convenient working position. Situated in the rear grip is a trigger switch which is protected against mechanical damage. A threaded journal of $\frac{5}{8}$ in. and a suitable flange hold the grinding disc which is protected by a sheet-steel wheel guard. The armoured grinding discs permit full use of the high power and cutting speeds available, and are made of resinoid-bonded fabric. They are claimed to be almost unbreakable and remove metal at an exceptionally rapid rate by applying only slight pressure.

Mr. D. G. PENNINGTON has been appointed an additional director of Pease & Partners, Limited, Tees Foundries, Middlesbrough.

The "Kaldo" Rotary-oxygen Steelmaking Process*

By Prof. Bo Kalling and Folke Johansson†

An important new steelmaking plant is now being used as a productive unit at Domnarvet, Sweden. The Authors have detailed the operational procedure, construction, and applications of the process, together with charge data and technical details, and the advantages gained by its utilization. Inasmuch as the new furnace is an adaptation of side-blown converter practice using oxygen enrichment the process has obvious application to steelfoundry melting.

In the decarburization of hot blast-furnace metal with pure oxygen, one method is to blow the oxygen from above the metal surface, through lances directed against, or into the bath. This process has been carried out so far in converters similar to those which are being used in the ordinary Bessemer process. The so-called LD converter, based on this principle, has already been accepted for production by several companies in Europe and the USA. The furnace operates in a non-rotating, upright position. However, a stationary furnace provides a very low stirring effect in the bath, even if the oxygen is blown at high pressure. As a result, a strong local temperature increase is obtained in the zone where the oxygen hits the steel bath; this causes a considerable evolution of iron as oxides, which following the exhaust gases, represent a considerable iron loss amounting up to 1 per cent. of the charge weight. The lack of stirring also makes it difficult to bring down the iron content in the slag, which is especially true when refining high phosphorus pig-iron.

Development

These characteristics, among others, have been overcome by using the oxygen process developed at the Domnarvet Steel Works belonging to Stora Kopparbergs Bergslags AB, Sweden. This is carried out in a rapidly-rotating furnace or converter. The oxygen is introduced through a central opening in one end which simultaneously serves as an outlet for the exhaust gases. In this way, a controlled stirring of the bath is obtained, independent of the method of introducing the oxygen. The stirring effect will be sufficient even if the oxygen is not blown into the bath, but only introduced above the surface at a low pressure. As a result, a less-strongly localized heat-evolution results, and the formation of fume can be kept down. At the same time the process is more flexible and it is possible to regulate the chemical reactions in the most favourable way by varying the speed of rotation, and the manner of oxygen injection. The first experiments along these lines were carried out in 1948 in a 3-ton rotary experimental furnace, which finally acquired the shape shown in Fig. 2. Since then, many test heats have been made in the same furnace.

A large unit for production was not erected until 1954 at Domnarvet, it was decided that the capacity of the furnace was to be 30 tons, as this is the same size as the Bessemer converters and electric furnaces of the plant. The rotating furnace was put into operation in May, 1956, and has since been in continuous commercial use, although, of course, at a low production during the first months. The process has not been worked out in detail for all different purposes, but the results so far obtained give a good idea of the potentialities of the method.

The principal features are shown in Fig. 1. The drawings and construction of the furnace were made by the Bamag Company in Germany. Fig. 3 is a picture of the furnace during the blow. The speed of rotation can be varied up to about 30 r.p.m., which speed usually has been found desirable during the main part of the blow.

Applications

The Domnarvet furnace is being used for refining high-phosphorus pig-iron, usually of the following analysis:—C, 3.5; P, 1.8 to 2.0; Si, 0.2 to 0.3; V, 0.1 per cent. Ore is mainly used as a means of cooling; however, heats cooled predominantly by scrap have also been carried out. The ore used has been the finer fraction of the usual sinter, containing 55 per cent. of iron. Using only ore, the addition has been 12 to 14 per cent. of the weight of pig-iron; under continuous operation, 14 per cent. is about normal.

By using scrap instead of ore, the cooling effect is not much more than one third of that of ore, which would correspond to about 40 per cent. scrap. The amount of lime necessary is about the same as required in the ordinary basic-Bessemer process, or approximately 13 to 14 per cent.

Operation

The efficient blowing time, so far, has been 35 to 40 min., using the ordinary high-phosphorus pig-iron, and cooling with ore. The time for the tap-to-tap cycle has been considerably longer, as at this early state, relatively long steps have to be made for sampling, temperature measurements, additions, and so forth.

The oxygen consumption can be varied within wide limits, depending on how the blowing is carried out. It can be greater, if it is desired to burn a greater amount of the CO inside the furnace, which in this case is possible, to improve the heat economy. At present, the consumption is about 2,300 to 2,500 cu. ft. per ton of pig iron. The operation is carried out without any losses due to boiling.

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* Abstracted from an article published by our sister journal, *Iron and Coal Trades Review*.

† This paper was presented by Prof. Bo Kalling at the Steelmaking and Transforming Industries Conference of the Economic Commission for Southern America held in Sao Paulo, Brazil, in October, 1956.

The "Kaldo" Process

A characteristic feature is that the phosphorus can be oxidized faster than the carbon and, if so desired, it can be brought down to 0.025 per cent. at a carbon content of 0.5 per cent., or still higher using pig-iron. As there is no difficulty in this process in "catching" the carbon at the desired content, there is not the same risk of over-oxidizing as in other pneumatic processes.

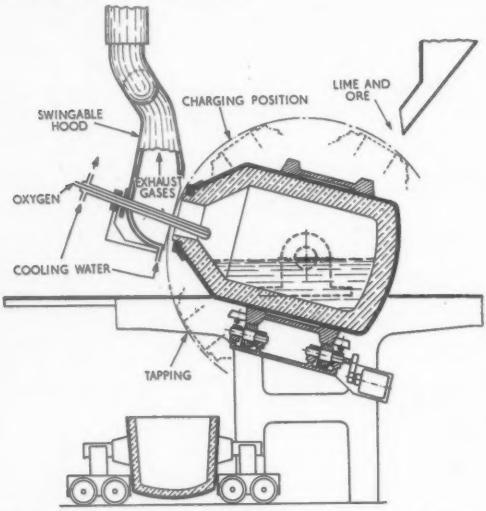


FIG. 1.—*The 30-ton rotary furnace shown in cross section in the blowing position, with the fume hood and water-cooled oxygen lance in position.*

It has proved advantageous to reslag at least once during the process when the main part of the phosphorus has been oxidized. As this pre-slag has a very low iron content (about 3 to 4 per cent.), the total loss of iron in the slag can be kept extremely low (Fig. 4).

The amount of iron in the exhaust gases is low in comparison with blowing in a stationary furnace, and it might not be necessary to have any gas cleaning. This is of importance, as effective gas cleaning is complicated and expensive due to the very fine iron oxide which is formed in the effluent.

The furnace has so far been lined with ordinary tar dolomite. The life of the lining has been about 50 heats, which is considered satisfactory under prevailing conditions but it could be increased. The net consumption of dolomite per ton of steel is about 45 lb., corresponding to about 4 per cent. of MgO in the slag.

The steel yield from the process is high. Calculated on charged pig-iron, the yield of molten steel will be about 92 per cent. To this should be added about 7 per cent. Fe reduced from the charged ore. The sulphur content is normally very low. With a pig-iron sulphur content of 0.060 per cent., the sulphur in the steel would be only 0.010-0.015 per cent. The nitrogen content is unusually low, approximately 0.002 per cent. at 97 per cent. pure O_2, depending on the method of supplying the oxygen.

Steel Yield and Properties

The properties of the steel have proved to be as good as of any open-hearth or electric-furnace steel of corresponding type. In certain respects a higher quality may be expected, due to:—(1) The low sulphur content, which will give better weldability, and because of less segregation and slag inclusions, improved transverse properties, and homogenity; (2) low nitrogen content, causing improved deep drawing properties and less ageing tendency; (3) lower oxygen content in the steel at the end of the blow, which gives a better starting point for deoxidation, and a cleaner steel.

Cost and Advantages

Regarding the construction cost, it should be mentioned that the increase for a rotating furnace is insignificant in comparison to the total cost of the plant. Although the most obvious advantage of the method will probably be found in the possibility to decarburize pig-iron which is high in phosphorus, the turbulence has so many advantages in other respects that the method is also expected to prove efficient and economical with other types of pig-iron. The method is suitable for pre-refining of iron for duplexing in other steel processes, as can be seen from Fig. 4.

The advantages of the process may be summarized as follow:—

(1) The heat economy is good, partly due to the possibility of burning most of the carbon monoxide to carbon dioxide inside the furnace. A large per-

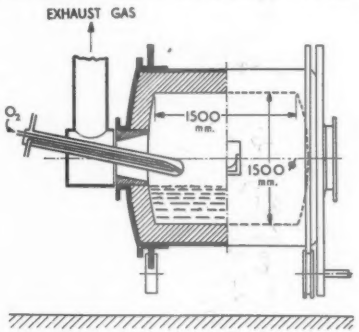


FIG. 2.—*Development furnace in which all the experimental work on the process was effected.*

centage of ore and/or ore scrap can thus be melted during the process.

(2) Great flexibility in operations. These can, if desired, be varied in different ways through changes in the speed of rotation, and the direction of the oxygen jet. If so desired, the process can be finished without oxygen addition, for instance, during alloying of steel.

FIG. 3.—*The Swedish "Kaldo" unit showing the lime and ore shute on the left, and the offtake hood with oxygen lance on the right.*

(3) Steel with higher carbon content can be made by "catching" the carbon at the desired content.

(4) The phosphorus content in the pig-iron can efficiently be reduced to very low values, while the carbon content is still relatively high.

(5) The sulphur content can be reduced to very low values.

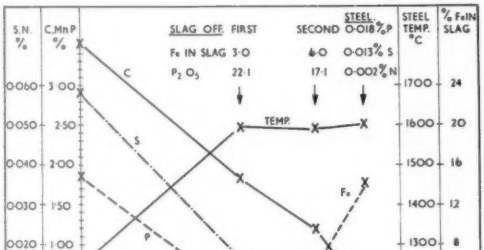


FIG. 4.—*Typical heat of high-phosphorus iron in the rotary converter.*

Charge data for Fig. 4:—Hot-metal weight, 30 tons; hot metal analysis (per cent.) C 3.54, Si 0.12, Mn 0.49, P 1.84, S 0.058; lime addition, 13.8 per cent. of hot metal; ore addition, 11.6 per cent. of hot metal; oxygen consumption, 2,300 cu. ft. per net ton of hot metal.

(6) The nitrogen content in the steel will be extremely low, even if the oxygen is of low purity.

(7) The iron loss in both slag and exhaust is usually low; a good yield can therefore be expected.

Venturi Blast-furnace Gas Washers

Construction and Operation

Venturi gas washers installed on two blast furnaces of the Bethlehem Steel Corporation, were described by L. W. Butz at a meeting of the Eastern Blast Furnace and Coke Oven Association held recently at Pittsburgh and referred to in *Steel*, March 18. These washers are said to have effected a seven to ninefold reduction of dust in the furnace flue gas. One of them, installed on a furnace in 1952, consists of a tower, set into the gas system directly beyond the dust catcher. The venturi throat narrows from the 8-ft. dia. of the gas main to a 1-ft. by 5-ft. 4-in. neck, from which the gas passes into a water separator, cooling tower and moisture eliminator. As the gas passes through the throat, it is sprayed with low-pressure water entering perpendicular to the gas flow and high-pressure sprays set at 100 deg. to the flow. The water enters through $\frac{7}{16}$-in. pipes, but the velocity of the gas is sufficient to atomize the coarse sprays and no special nozzles are required.

The venturi is lined with a fused-cast composition of aluminium oxide and chrome. An inspection after 21 months of operation showed a minimum of wear had occurred. In double that period there were no furnace delays caused by the washer, this is partly attributable to the fact that the spray pipes have manual cleaning plungers that can be operated without shutting down the gas-cleaning unit.

Regarding cleaning efficiency, the venturi replaced a conventional wash tower which was delivering gas to the primary mains, with a dust content of 0.36 grain per cub. ft. Since installation of the venturi, top pressure on the furnace has been increased from $2\frac{1}{2}$ to $3\frac{1}{2}$ lb.; flue-dust rate has dropped from 190 to 87 lb. per ton; furnace output has increased and fuel ratio decreased. Further, the dust content of the flue gas delivered to the mains has dropped to 0.048 grain per cub. ft., much of this improvement is said to be attributable directly to the venturi. The improved cleanliness not only has a favourable general effect, but it reduces gas line, precipitator and gas-engine maintenance.

In 1954, Bethlehem fitted a much simplified version of the venturi into the pipes leading from another of its furnaces into two standard wash towers. This installation has also been successful, resulting in a lowering of dust content in the gas from 0.38 to 0.04 grain per cub. ft. The company is stated to be planning incorporating of venturis in all future furnace rebuilds.

Canadian Order for M-V

An order, valued at $5,500,000, from the Montreal Engineering Company, Limited, for two 150-mw turbine-generator sets, complete with condensing, feed-water heating, and de-aerating plant, has been given to the Metropolitan-Vickers Electrical Company, Limited.

The equipment, which is to be installed at the Wabamun power station of Calgary Power, Limited, where the first of two M-V sets of 66-mw capacity was recently commissioned, will be manufactured at the Trafford Park, Manchester, and Germiston, Glasgow, works of the company.

Siting of New Steelworks

Welsh delegations to London to press the claims of the principality to have the £160,000,000 steelworks planned by Richard Thomas & Baldwins, Limited, have been followed up by a visit to London of the Scottish TUC general secretary and treasurer, Mr. George Middleton and Mr. John Lang, to press the claims of Scotland. On May 9 they met the chairman of the Iron and Steel Board, Sir Archibald Forbes, the deputy chairman, Sir Lincoln Evans, Mr. John Maclay, Secretary of State for Scotland, and Mr. F. J. Erroll, Parliamentary Secretary to the Board of Trade. It was stated that from every possible angle, the siting of the new plant at Grangemouth would be a big factor in the development of the British economy.

A TUC statement added that if private interests in the steel industry "boggled" at the proposal to establish a steel strip mill in Scotland, the Iron and Steel Board must exercise its powers and provide the mill itself. Much as it sympathized with Wales's unemployment problem, the TUC felt it would not be sound policy to allocate another strip mill to Wales. Scotland had dropped from third to fourth place among steel-producing areas and Wales had gone up from second to first. Other industrial projects should be found for Wales to provide variety and balance to the Welsh economy.

"All its Eggs in One Basket"

At the same time in London, a deputation from the West Wales Federation of Trades Councils presented its case for a site to be chosen in west Wales, to Sir Lincoln Evans. On May 13, the Morriston (Glam) Chamber of Trade announced that "as a matter of extreme urgency" sites in west Wales, other than the original one at Kidwelly, near Llanelly, should be put forward for Government investigation. Continued pressure on sociological grounds to get the plant sited at Kidwelly might result in the plant not being built in Wales at all. It would be better, the chamber stated, for Newport (Mon) to have the plant rather than it should go to England or Scotland. Meanwhile Mr. S. J. Havard, district organizer of the NUGMW, said in Swansea that if the new steelworks caused the closure of west Wales foundries, the area could have more than 15,000 redundant workers in a very few years.

In Scotland, Stirling County Council decided on May 11 to approach the Scottish Council (Development and Industry) for its support in getting the plant for Grangemouth, and also to seek the support of the Association of County Councils. The view was taken that, apart from the industrial possibilities of Grangemouth, there was the civil defence aspect. If the mill went to Wales, the Government would have "all its eggs in one basket." A deputation from the County Council and Mr. Arthur Woodburn, MP for Clackmannan and East Stirlingshire, met Lord Polwarth, chairman of the Scottish Council, in Edinburgh on May 13. The executive of the Scottish Council considered the strip mill project on May 17.

Nickel Exhibition

The Mond Nickel Company is to stage an exhibition, featuring the properties of nickel and related materials, at the Engineering Centre, Stephenson Place, Birmingham 2, from May 28 to 31. Many of the exhibits take the form of working demonstrations. Admission is free—or should it be one "nickel"?

Technical Education

In a circular from the Minister of Education, Lord Hailsham, education authorities and principals of technical colleges are warned that the humanities must not be forgotten in the Government's all-out drive for the expansion of technical education. The Minister wants a liberal element "injected" into technical courses and he suggests various ways in which this may be brought about. Students, he feels, should learn something of the history of their particular science or technology and the depth of its social and economic impact on human society; there should be an increased use of college libraries and of the less formal methods of teaching. The fullest encouragement and facilities should be given for the development of corporate life in the technical college and for activities outside the set curriculum; and the establishment of close contacts with institutions abroad also offers opportunities for liberalizing technical courses. Lord Hailsham is aware that a governing factor will be the task of introducing additional subjects into an already full curriculum and that the "liberal element" in a technical course depends as much on how subjects are treated as on what is taught. This, as principals and heads of technical colleges and schools will agree, is the crux of the matter.

TV for Combating Smoke Nuisance

A closed-circuit television system is being used as an aid to controlling the amount of smoke being produced by steam boilers at the Ford Motor Company, Limited, Dagenham. The system gives a double check by providing a continuous visual picture of the amount of smoke emitted. A camera, mounted on a nearby roof, is focused on the four chimney-stacks of the power station and the picture is relayed to two monitor receivers, with 12-in. screens, one in the operational engineer's office and the other in the steam engineer's office. To ensure the best possible picture, the camera lens is continually and automatically washed; obviously, the T.V. system is effective only in daylight. Apart from the smoke-abatement angle, the system also helps to ensure that the boilers are working at maximum efficiency. A lot of smoke could mean bad operation, uneconomical burning of fuel, failure of the draught fans, a sudden change in the rate of firing, and various other faults.

Technological Awards

The following courses now in progress have been recognized by the National Council for Technological Awards as leading to the award of a diploma in technology:—

College:	*Sandwich course in:*
Birmingham College of Technology	Metallurgy
Wolverhampton & Staffordshire College of Technology	Mechanical Engineering

The Council have also approved the following proposals for new courses:—

College:	*Full-time course in:*
Northern Polytechnic	Applied Chemistry
	Sandwich courses in:
Northern Polytechnic	Applied chemistry, Physics, and technology of electronics
Borough Polytechnic	Chemical technology
	Electrical engineering

Details of other courses approved in the future will be issued by the Council from time to time.

Aluminium in Electrical Engineering

Symposium organized by the Aluminium Development Association

At the symposium on Aluminium in Electrical Engineering held last week at the Institution of Electrical Engineers, Victoria Embankment, London, W.C.2, twelve papers were presented. They covered diverse subjects from the use of aluminium in the British telephone service to jointing processes for the metal. Of the twelve papers then presented, two emanated from the continent (one from Germany and one from France). Below are extracts from three of the papers which have major application to foundry practice.

"Aluminium and its Alloys in Electrical Engineering"

In this paper, the Authors, C. H. E. Ridpath, B.SC., M.I.E.E., and D. F. J. Worth, B.SC., A.M.I.E.E., in addition to surveying the earlier uses of aluminium as an electrical conductor for overhead lines, busbars, insulated cables and windings, described briefly the uses of aluminium as a constructional material for casting. What follows is an abstract. "The range of components that may be produced as aluminium-alloy castings is very wide, ranging from very small, accurate pressure-die-castings to large, complex sand castings for components of heavy electrical equipment. For stressed parts, gravity-die-castings may be recommended and often their mechanical properties are enhanced by heat treatment." Table I gives the composition and some properties of the more popular casting alloys, listed in B.S. 1490.

The Authors proceeded to give a brief indication of the foundry processes for which these alloys are appropriate and continued, "LM 2 and LM 24 are particularly suited to pressure-die-casting of small, accurate parts; LM 4 and LM 6 are widely used for sand and gravity-die-casting, with LM 22 having a composition similar to, but more closely controlled than LM 4, and enabling subsequent heat-treatment to produce castings with greater strength and ductility. LM 6 and LM 8 are alloys with low copper content and good corrosion resistance, again suitable for larger sand and gravity-die castings."

"Aluminium in the British Telephone Service"

In this paper, the Authors, J. Gerrard and T. P. A. Urben, B.SC., stated that in making telephone equipment, aluminium is used extensively for die-cast frames of complex form. Referring to the subscriber's instrument, the Authors said "In this, the most important application of aluminium is in die-castings (LM 6) in the earpiece and the base of the instrument. The advantage of aluminium here is the ease of casting and light weight. Use is also made of it for the diaphragm of the microphone (NS 7) which, of course, must be extremely light to respond to the variations of air pressure and must also be flexible and a good conductor." Moving on to the question of the automatic switch, the paper states "Probably the greatest quantity of aluminium in the telephone exchange is to be found in the components of the automatic switch itself, and here it is not primarily the lightness of the aluminium which is of advantage, although this does play an important part. To take one example of automatic switch, the 2-motion

TABLE I.—*Composition and Properties of Some Aluminium-alloy Castings for Use in Electrical Equipment*

	Composition (per cent.). Single values are maxima unless otherwise stated.									Condition.	Minimum tensile strength.	Minimum elongation on 2 in.
	Al.	Cu.	Mg.	Si.	Fe.	Mn.	Ni.	Zn.	Other Elements		(tons per sq. in.)	Per cent.
LM2	rem.	0.7 to 2.5	0.30	9.0 to 11.5	1.0	0.5	1.0	1.2	Ti 0.2 Sn 0.2 Pb 0.3	M* chill cast	9.5	—
LM4	rem.	2.0 to 4.0	0.15	4.0 to 6.0	0.8	0.3 to 0.7	0.3	0.5	Ti 0.2 Sn 0.05 Pb 0.1 (Mn+Fe 1.3)	M* sand cast	9.0	2
										chill cast	10.0	2
LM6	rem.	0.1	0.10	10.0 to 13.0	0.6	0.5	0.1	0.1	Sn 0.05 Pb 0.1	M* sand cast	10.5	5
										chill cast	12.0	7
LM8	rem.	0.1	0.3 to 0.8	3.5 to 6.0	0.6	0.5	0.1	0.1	Sn 0.05 Pb 0.1 Ti 0.2 Nb	P* sand cast	9.5	—
										P* chill cast	12.0	2
										W* sand cast	10.5	2.5
										W* chill cast	15.0	5
LM22	rem.	2.8 to 3.8	0.05	4.0 to 6.0	0.7	0.3 to 0.6	1.5	1.5	Pb 0.05 Sn 0.05 Ti 0.2 Nb	W chill cast	16.0	8
LM24	rem.	3.0 to 4.0	0.1	7.5 to 9.5	1.3	0.5	1.0	1.0	Pb 0.3	M chill cast	11.5	1.5

* M = As cast. P = Precipitation treated. W = Solution treated.

Aluminium in Electrical Engineering

selector, this is ratchet driven by the electrical impulses generated by the subscriber's dial and, therefore, the mechanism has to withstand the repeated shock of the impact of the pawl on the ratchet mechanism. These shocks occur at the rate of 10 per sec. or more, and it is necessary that the mechanism should be able to withstand this treatment for a life approaching 30 years without the failure of the framework, while it is impossible to allow space for a very sturdy construction of framework due to the great quantities of such mechanisms required in any one exchange. At one time the use of a zinc-base die-casting was attempted for this framework but it was insufficiently strong to accept the continuous ratchet shock and the result was fracture of the shaft mounting arm. The standard now is an aluminium/silicon (LM 6) die-casting with a tensile strength of approx. 10 tons per sq. in. This material does not require heat-treatment and is, therefore, suitable in that the production costs are kept low. A die-casting is found necessary, as the dimensions of the switch parts have to be to close tolerances in order that reliable operation may be obtained from any replacement parts of five different manufacturers in any desired switch. This has resulted in an extensive measure of standardization of parts and manufacturing processes."

"German Experience with Aluminium in Electrical Equipment"

In his Paper, Dr. W. v. Zwehl discussed the constructional uses of aluminium in the following abstract, "Besides the applications of aluminium as a conductor material, there is a very wide field for its use as material for structural parts in electrical equipment, mainly as castings. In this application, the fact that aluminium is non-magnetic is a general advantage; in addition may be mentioned its low weight, ease of casting of difficult and complex shapes, and the small amount of machining required—often, especially on pressure-die-castings, none at all. Such constructional applications include shields for generators, motor casings, parts of electrical tools, and rotary converters. Also there are innumerable possibilities in the fabrication of switchgear and of instruments and meters."

In his Paper "French Experience with Aluminium Conductors in Electrical Equipment," Mr. P. Jacomet said that "squirrel-cage rotors, made by centrifugal or pressure-die-casting, are becoming increasingly popular."

Other Papers

Other papers presented during this symposium were:—"Fundamentals of Jointing Processes for Aluminium," by J. C. Bailey, B.SC., and P. Gregory, A.I.M.; "Aluminium in High-voltage Transmission Lines," by G. B. Jackson, D.F.H.; Aluminium for Ovérhead Distribution Lines," by R. Cloke and R. Fyfe; "Medium- and Low-voltage Insulated Aluminium Conductored Cables for the Distribution of Electricity," by G. F. Peirson; "Use of Aluminium in the Construction of Transformers," by F. W. Gee, B.SC., and R. J. Gresley; "Aluminium and Aluminium-alloy Busbars," by A. R. Parish, B.SC.; "Aluminium in Telecommunications Cables," by R. C. Mildner, M.SC., and B. F. Thorne, B.SC., and "Economics of Aluminium in Electrical Engineering," by Dr. E. G. West, F.I.M.

Scottish Orders

The Cummins Engine Company, Limited, tested and delivered from their Shotts (Lanarkshire) works, the first high-speed diesel engine, a 335 h.p. model for Euclid (Great Britain), Limited, on May 9. The objective of the company is to manufacture a wide range of British-built high-speed diesel engines in the 200 to 335 h.p. range to meet the growing needs of world markets. Cummins Engine Company, Limited, are a wholly owned subsidiary of the American parent of Indiana, but it was stated last week by the managing director, Mr. D. J. Cummins, that it was possible that local directors are to be appointed and local capital employed. Further orders have been received from Spain, France, and Kuwait, and it is estimated that about 75 per cent. of the total output will be exported.

A £250,000 order to supply turbine-generator sets to a Canadian firm has been placed with the Glasgow factory of Metropolitan-Vickers Electrical Company, Limited. The order—which will be paid in dollars—is part of a £5,500,000 contract placed with the firm. Most of the work will be carried out at the company's Manchester works.

G. & J. Weir, Limited, Glasgow, have received an order for the main coolant pumps on the pressurized-water circuit of the land-based reactor prototype of Britain's first nuclear vessel H.M.S. Dreadnought. These pumps will be of the canned motor type and are being developed in collaboration with the English Electric Company, Limited.

Course in Industrial Engineering

A one-year residential post-graduate course in industrial engineering has been organized by the Department of Industrial Engineering of the Loughborough College of Technology. Enrolments are now being accepted for the new session which commences on Tuesday, September 17, 1957, and extends to July 11, 1958. The course will provide advanced education and training facilities for production administration and management positions. The subjects include industrial, financial, factory and personnel aspects of management; industrial economics, law and psychology; work-study; product development and distribution; higher business control; men and machines; technology of automation and industrial application of nuclear energy.

An essential condition of entry is that members must have had at least one year's industrial experience (in any branch of productive industry) and be either graduates with degrees or diplomas in science subjects or holders of Higher National Certificates in Engineering of good standard, or nominated by companies as being suited to receive such training. Further information may be obtained from:—the head of the Department of Industrial Engineering, Loughborough College of Technology, Leicestershire.

Mr. F. WARHURST, commercial manager since 1949, has been appointed commercial director of the Brush Electrical Engineering Company, Limited.

Book Reviews

Foundry Air Pollution Control Manual. Published by the American Foundrymen's Society Inc., Golf and Wolf Roads, Des Plaines, Illinois, USA. Obtainable from the Penton Publishing Company, Limited, 2, Caxton Street, London, S.W.1; prices, to members £2 3s. and to non-members £2 17s., both including postage.

The emission of grit, fume and smoke from foundries has been a growing municipal problem, and now—with the introduction of the Clean Air Act—the foundry industry in this country will be called upon to make every endeavour to achieve a higher degree of control of any emissions which cause atmospheric pollution. This manual gives an excellent survey of the sources of air pollution in all sections of the foundry industry; it has been compiled by competent engineers and executives associated with the American foundry industry, and dust-control-equipment manufacturers.

American foundries in certain areas, notably Los Angeles and Pittsburgh, have, because of stringent air-pollution regulations, spent a great amount of money and given extensive study to ways and means of reducing or eliminating the emissions from foundries. The information contained in this manual is largely the results of that work, and deals with such matters as emissions from melting furnaces, knocking-out and dressing operations, etc. Mention is also made of odours from core ovens, etc., and gaseous emissions. Such pollution problems and their control are stated in sufficient detail to interest foundrymen, for whom air pollution is, after all, an added complication to their main business of making castings.

One chapter is devoted to "community relations," in which it states that Court actions for abatement of nuisance or damage claims are increasing, which represent a considerable awareness of "air pollution" by the general public. These emphasize that it is better to instal control equipment before complaints are received, as the degree of control imposed will be appreciably less than would be necessary after complaint had arisen. Examples of favourable and unfavourable meteorological and site conditions are shown, which underline the fact that it is not only what pollution the foundry produces but "where and when" that can greatly affect the magnitude of the problem of mitigation.

The principles governing maintenance work on collection systems are enumerated in a chapter, which also deals with means of reducing air pollution from cupolas and melting furnaces by careful design and control of operating conditions. Two opinions are quoted on the amount of smoke emitted being affected by the comparative distance between the bottom of a cupola and the charging door. The second opinion, which states that extra charge height may give rise to increased smoke emission troubles, is confirmed by experience in this country.

The manual gives a most interesting review of existing legislation, atmospheric-pollution codes and control ordinances. Technical aspects of the various codes constitute an extensive field, but some similarity to part of this subject matter appears in the "Clean Air Act" which now represents the law in this country.

The publication of this manual at a time when the foundry industry in this country is becoming "clean air" conscious is most opportune, and its acquisition is to be recommended to British readers.

W. H. W.

Manufacture of Iron and Steel. 2nd Edition, vol. 1, Iron Production, by G. R. Bashforth. Published by Chapman & Hall, Limited, 37, Essex Street, London, W.C.2; price 45s. net.

This work has already established itself amongst metallurgical literature as a useful introduction to the production of iron, and the appearance of the second edition will be welcomed both by students of metallurgy and industrial metallurgists.

The end-of-chapter bibliographies which were a useful feature of the first edition have been brought up-to-date, and the conclusions given in recent papers have been incorporated in the general body of the text. This is particularly true, for example, in the case of the chapters dealing with the preparation of iron ores, refractories and alternative methods of iron production.

This new edition, which runs to 306 pages, is adequately illustrated—119 figures, well printed and bound, and it can confidently be expected to continue to occupy a valuable position in the literature of iron production.

J. E. G.

Proceedings of the Institute of British Foundrymen, Vol. 49. Published from St. John Street Chambers, Manchester, 3.

This volume is the last which will appear in its present form, and not a few members will regret its passing, as custom had made it a handy source of reference. The contents take the usual form of a complete report of the annual conference of the Institute, together with a selection of the best papers read before the branches.

Publications Received

Drivers Handbook for all C-Licence Holders. Published by Traders Road Transport Association, Limited, 146, New Bond Street, London, W.1; price 10s. 6d. per dozen.

This is produced in the format used for the Highway Code—that is, pocket size. In Part I, the conditions governing the employment of drivers and van boys are clearly set out. Part II details the law relating to goods vehicles, and here is included a typical journey record sheet. Part III covers the law relating to driving, and there are set out in simple language all the various actions a driver is required to take in any given circumstance. Especially useful are the instructions given in case the driver is involved in an accident. Part IV is devoted to some driving hints and, unquestionably, the careful observance of these would be a real factor in the reduction of road accidents. Part V covers the care of tyres and has obviously been prepared by an expert on the subject; this is certainly another worthwhile section. The reviewer wholeheartedly recommends the acquisition of this little book by all users of "C" licensed vehicles.

Britain Leads in this Atomic Age. Published by the Nuclear Energy Trade Associations' Conference, 32, Victoria Street, London, S.W.1.

This interesting brochure gives details of Britain's nuclear programme. It is being widely distributed overseas. The trades represented by this organization are anxious to enter the export market since the British certainly are the pioneers in the application of nuclear energy to civil activities. Space was taken at the Hanover Fair, and accompanying this brochure is a folder telling of the Association's activities in French, German, Spanish, Portuguese, Russian, Chinese, and Arabic.

New Catalogues

Unless otherwise stated, JOURNAL readers can usually obtain copies of these publications by writing (on their firm's letter-heading) to the address quoted.

Ferrous Castings. A new note has been struck by Lloyds (Burton), Limited, Wellington Works, Burton-on-Trent, in their recently-issued brochure "Flow Production." In this the reader is taken—stage by stage—from the blue-print to finishing and despatch. No fewer than 20 stages are described and illustrated and in each case "flow production" is stressed. Roughly translated, this means the measures taken to make sure of being of maximum service to the customer, whilst quality is implied throughout. This excellently produced booklet, which runs to 32 pages, certainly does set out very impressively all the various activities which are undertaken to supply a casting which will give satisfaction to the buyer. In addition, some notes are included on some of the newer foundry developments such as ductile iron, shell moulding and mechanized coremaking. Finally, quite a few pages are devoted to illustrating a wide range of castings produced at Burton. Here the brochure—*force majeure*—loses some of its earlier glamour, but it is difficult to see how a different and better treatment could be given. Devoid of the hard facts and specification information contained in this section, the brochure would lose much of its lasting value to buyers.

CO_2 Process. Wm. Aske & Company, Limited, Victoria Works, Waterside, Halifax, have issued a binder of the loose-leaf type (possibly to accommodate particulars of later developments) to give details of the new Gasbinda grade X5 which the firm have developed as a binder for use in applying the CO_2 Process. A page has been devoted to export packing data, whilst another tells of the establishment of a complete works for the production of material for the Process, for in addition to the binder, there are about half-a-dozen other items being made—such as coatings, jointing pastes, parting agents, and core-breakdown additives. Throughout the brochure, the reader is taken stage-by-stage through the Process and the final "hints" recorded are certainly substantiated by practical reports.

Lifting Tackle. Three catalogues have been received from Felco Hoists, Limited, 29, Cromwell Road, London, S.W.7. The first, R.H.2, deals exclusively with ratchet hoists from 1- to 6-ton capacity. Operating data, details and prices, and typical applications are included. The second, WR.16, covering electric pulley-blocks, is well illustrated and contains full details as to the lifting height obtained with various types and capacities, together with prices and operating data. The third catalogue, S.J.C.-1, deals with swing-jib cranes and portable gantries. Here, again, these are illustrated, and the range of standard sizes and capacities and dimensions are given.

Chemicals and Plastics. A colourful brochure issued by Monsanto Chemicals, Limited, 10-18, Victoria Street, London, S.W.1, lists all the various chemicals the firm makes and the contents are illustrated with photographs of the plant used. Later, each industry served by the company is listed and beneath each name is set out the chemicals placed at their disposal by the Monsanto group. The foundry industry is not set out separately, but is lumped in with iron and steel.

House Organs

Albion Works Bulletin, Vol. II, No. 3; issued by John Harper & Company, Limited, Albion Works, Willenhall.

This issue reports on a visit made by a party of the grey-iron foundry personnel to Brook Motors, Limited, Huddersfield (for whom, Harper's make a number of electric-motor castings). Also included are notes on the Cologne Fair and a report of the social events of the works. When referring to the exhibits at the Fair, a comment is included that, in general, hardware products of continental manufacture were not finished with the same attention to detail as their British counterparts. Similarly, in discussing mincers, it is recorded that the castings and tinning were not up to UK standards.

Bradley's Magazine, No. 68; issued by Bradley & Foster, Limited, Darlaston, Staffs.

This is a very good issue, and carries two interesting articles. The first is on "Fluxes and Slags in Cupola Practice" and the second "Little-known Metals with a Bright Future." The little-known metals are beryllium, titanium, and zirconium. The first article raises the question as to whether it is preferable to use pure limestone or magnesian limestone. The author's non-committal verdict is that "a good-class magnesian limestone is in no way inferior to a good-class straight limestone." Thus it would seem that price alone is the governing factor in this instance.

Tisco, Vol. 4, No. 1; published by the Tata Iron and Steel Company, Jamshedpur, India.

This issue is entirely devoted to an article by S. N. Sircar and P. H. Tata on the modernization and expansion programme of the company's works at Jamshedpur, though there is only one paragraph of the foundry. It is stated that the output of the ingot-mould foundry, now about 30,000 tons of ingot moulds and stools per year directly cast from blast-furnace metal, is to be stepped up to 37,000 tons per year.

Wiggin Nickel Alloys, No. 43; issued by Henry Wiggin & Company, Limited, Wiggin Street, Birmingham, 16.

This issue contains an interesting article on the Toronto subway, the rolling stock for which was built by the Gloucester Railway Carriage and Wagon Company, Limited, with heating apparatus by J. Stone & Company, Limited. Other articles dealt with include marine gas-turbines, mercury-arc rectifiers and corrosion prevention in nuclear engineering.

Sif-Tips, Vol. 22, No. 96; issued by the Suffolk Iron Foundry (1920), Limited, Sifbronze Works, Stowmarket.

The main article—"From Spiders to Pins"—is largely devoted to the building up of worn components of motor-cars, and should prove useful to garage proprietors catering for those people desiring to retain their cars for a few more years, whilst ensuring good performance. A second article covers the welding of cast-aluminium parts, but here fractures are dealt with.

Turnbridge News, Vol. 2, No. 2; issued by W. C. Holmes & Company, Limited, Turnbridge, Huddersfield.

This issue contains biographical notes of Mr. H. Davis and Mr. J. Kaye, both of whom have spent 40 years in the employment of the company.

Drill "Life" and Point Shape

Recommendations from the Production Engineering Research Association of Great Britain

Since the modern form of twist drill machined from a solid bar came into general use nearly 100 years ago, there has been considerable progress in developing different types of drill for special purposes, such as drilling deep holes. Unfortunately users generally have failed to appreciate the importance of correctly specifying and grinding the drill point, with the result that even to-day low standards of drill performance are accepted as a matter of course in many companies. To assist industry in reaching optimum levels of drilling efficiency, extensive research has recently been carried out by the Production Engineering Research Association (PERA) into the influence of drill geometry; cutting conditions; machine tools; cutting fluids, etc., on drill life, hole accuracy and alignment; cutting forces and chatter vibrations. These researches have thrown new light on the fundamental reasons for some common difficulties in drilling.

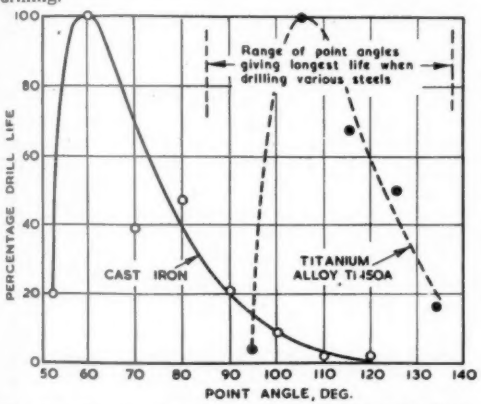


FIG. 1.—*Effect of point angle on drill "life" in various materials.*

Geometric Features

The geometric features of a drill may have a marked effect not only on tool life, but on rate of production; power consumption; hole accuracy, and surface finish, although these effects vary considerably under different conditions. The improvements that can be achieved in performance by altering the shape of the drill point to suit the material drilled are indicated in Fig. 1, from which the critical nature of the geometry can be clearly seen. Actual test results are shown for cast iron and a titanium alloy, and the range of point angles giving optimum drill life when machining the various steels included in the investigation is also indicated. Although drills are commonly ground with a point angle of 118 deg., irrespective of the material drilled, the graph shows that the point angle giving longest drill life varies considerably with the material drilled.

Optimum Conditions

For the PERA tests on cast iron, $\frac{1}{4}$-in. dia. holes were drilled at a speed of 154 ft. per min. and a feed of 0.010 in. per rev. Under these severe conditions, drills with a point angle of 120 deg. failed after a few holes, whereas 60-deg. point-angle drills had an average life of more than 600 holes. Although random variations in machining conditions may prevent gains of this magnitude being achieved in production operations, substantial improvements in drill performance have been reported where firms have applied PERA recommendations for point shape. As the most suitable point shape for drilling cast iron depends partly on the drilling conditions and partly on the iron drilled, various recommendations covering a range of conditions have been made by PERA following another series of tests carried out in the Association's laboratories and in members' machine shops.

Results reported by companies applying PERA's recommendations on the drilling of cast iron include a 5:1 increase in drill life at the same time as penetration rate was increased by more than 30 per cent. Some other companies have also reported increases of four or five times in drill life under production conditions. It must be emphasized, however, that the most suitable point shape for drilling cast iron is critically dependent on the type of cast iron drilled, and the cutting speed and feed. To get optimum results the point angle may have to be varied over quite wide limits under different conditions.

British Foundry Acquired by Black-Clawson Group

Negotiations for the acquisition by Black-Clawson International, Limited (a wholly-owned subsidiary of the Black-Clawson Company of America), of the share capital of W. A. Baker & Company, Limited, engineers and iron and steel founders, of Newport (Mon), have been successfully concluded. W. A. Baker & Company is a wholly-owned subsidiary of the Whitehead Iron & Steel Company, Limited. The proceeds of the sale are expected to realize about £1,000,000.

To finance part of the purchase, Black-Clawson International has increased its issued capital by £400,000 to £600,000 and has issued £600,000 6 per cent. debenture stock repayable over 25 years. The Black-Clawson group is stated to be the world's largest manufacturers of pulp and paper machinery. W. A. Baker & Company has recently devoted most of its production to Black-Clawson International, and its new foundry, specially constructed for the production of drying cylinders, will shortly start work on 342-in. cylinders for the Great Lakes Paper Company in Canada. They will form part of the largest newsprint machine ever made.

New Patents

(Copies of complete specifications are obtainable from the Patent Office, Sales Branch, 25, Southampton Buildings, Chancery Lane, London, W.C.2, price 3s. 6d.)

771,503. Erwin Buhrer, 117, Alpenstrasse, Schaffhausen, Switzerland.

An attachment for foundry moulding-machines, with a mechanically-driven intermittently-rotatable turntable which carries at least two patternplates. The attachment, arranged so as to connect with the turntable, is adapted to be swivelled over the turntable. It includes controlled-holding means for gripping a mould box confining a finished mould. If desired the holder can be used for lifting the moulding box over a patternplate on the turntable and for carrying the moulding box away, or for gripping an empty moulding box and feeding it to a patternplate on the turntable.

771,538. National Research Council, Ottawa, Ontario, Canada.

Non-ferrous ferro-magnetic alloys, *i.e.*, magnetic alloys consisting of essentially two or more non-ferrous elements. The object of the invention is to utilize manganese-rich alloys in place of strategically important scarce metals such as cobalt and nickel.

771,879. British Iron and Steel Research Association, 11, Park Lane, London, W.1.

This invention relates to apparatus for pouring liquid metal employing funnels or nozzles, from containers. Existing nozzles tend to cause splashing and irregular flow especially into small moulds. The invention modifies the funnels by providing one or more diametrically placed grooves in the top of the funnel. The groove acts by reducing swirl.

771,952. Dow Chemical Company, Midland, Michigan, USA.

Titanium-base alloys. The patent relates more particularly to improved alloys containing aluminium and zirconium, which results in an alloy of high strength as well as acceptable durability.

772,044. Chromium Mining and Smelting Corporation, Limited, Sault Ste Marie, Ontario, Canada.

A process for the production of low-carbon ferro-alloy, *e.g.*, ferro-chromium from high-carbon ferro-alloy in a vacuum furnace wherein the carbon is oxidized, substantially without fusion, by solid oxidizing agents, including an oxide of iron.

772,214. Siemens and Halske, G.m.b.H., 12, Apostelgasse, Vienna, III, Austria.

An arrangement for the vibration or acoustic irradiation of molten metal. Mechanical vibrations are transmitted to the metal by means of the transmission liquid of the hydraulic system of a hydraulic lifting, tipping support, by the similar arrangement of a container for the metal.

772,261. Stone-Wallwork, Limited, Bleasby Street, Oldham, Lancs.

A machine for making shell-moulds provided with a pattern-ejecting device. This comprises a vibrator, or vibrators, arranged for acting on the patternplate in the machine to produce ejection of the pattern from the shell.

A CONTRACT, valued at £1,181,689, for the supply of steel towers and the erection of all the steel lines in the Northern Iraq electric system, has been awarded to Balfour, Beatty & Company, Limited (controlled by Power Securities Corporation, Limited), by the Iraqi Development Board.

British Standards Institution

The April, 1957, *Information Sheet* of the British Standards Institution lists under "New British Standards," an addendum to B.S.1902 Methods of testing refractory materials. Methods for the direct determination of alumina, price 3s. 6d.; and B.S.2846:1957, a book by J. T. Richardson, "Reduction and Presentation of Experimental Results," price 10s.

Part 1 of the addendum specifies a method for the direct determination of alumina in silica rocks, sands and silica refractories containing from 0.1 to 10 per cent. alumina, and Part 2 specifies a method for the direct determination of alumina in alumino-silicate refractories and raw materials containing from 10 to 65 per cent. alumina. The "classical" method for the estimation of the alumina content by difference in silicate analysis is given in B.S.1902, and it is recommended that the method given in addendum No. 1 should in general be used in preference to the difference method. The book by Mr. Richardson is intended to meet the need for a statement of generally accepted procedures for reducing and presenting the results of experiments in scientific and technological fields. Rules are prescribed for doing this, and are illustrated by a number of examples. The book shows how to assess the limits of confidence relating to the mean and to the standard deviation of a set of observations. The preparation of control charts is also briefly discussed.

Under "New Work Started" appears five revisions of standards for the petroleum industry. These are revisions of B.S.1414 for flanged steel outside-screw-and-yoke wedge-gate valves; B.S.1570 standardizing flanged steel-plug valves; B.S.1735 detailing flanged cast-iron gate valves, classes 125 and 250; B.S.1868 concerning flanged steel check valves; and B.S.1873 for flanged steel globe valves. Reprints now available include 1121 Part 3:1948 Determination of tungsten in steel not containing niobium (columbium) and tantalum, the price of which is 2s. 6d., and S 108:1949 Chromium/nickel heat-resisting steels, price 1s. 6d. Included in "Draft Standards Circulated for Comment" is CX 3818 Dimensions of poppet valves, collets, valve guides, valve seat inserts, and tappets for i.c. engines.

Babcock and Wilcox's Steel Supplies

Volume of work in hand is still encouraging, but the company confesses to some degree of anxiety as to the extent of future steel supplies and is endeavouring to minimize as far as possible the effects of shortages, states the chairman, Mr. W. Lionel Fraser, in the annual report of Babcock & Wilcox, Limited. Increased costs further eroded the profit margin and the net profit is £1,527,844, against £2,213,748.

During the year pressure of capital expenditure and the necessity of holding larger stocks of certain raw materials resulted in an overdraft (parent company) of £378,744, compared with a cash holding of £592,894 at the end of 1955. Group fixed assets have increased from £8,677,663 to £10,508,510, and the ordinary dividend is maintained at 15 per cent.

A NEW DEPOT at Scrabster, on the extreme northern coast of Scotland, is being built by Shell-Mex & B.P., Limited, to feed the new Dounreay atomic plant and to supply petroleum products to north-eastern Scotland. The new depot which will have a storage capacity of more than 1,500,000 gallons will cost about £200,000.

Water-cooled Cupolas at Ford's

Experience Gained at Dearborn Plant

Mr. P. H. B. Hamilton in *Canadian Metals* has reported the proceedings of a meeting of the Eastern Canada chapter of the American Foundrymen's Society, when a talk was given by Mr. W. Dawson on the Ford Motor Company's experience with water-cooled cupolas.

At Ford's Dearborn, Michigan, works, there are seven cupolas with a normal operations programme consisting of six cupolas working a 16-hour day to give a total production of 2,500 tons of metal per day. They are Whiting designed, 102-in. dia. shell, lined to 74 in. It was in this shop at Dearborn that a water-cooled cupola was developed, but Mr. Dawson pointed out that a hot-blast system for the water-cooled cupola had not as yet been incorporated, but this would follow as a later development.

The cupola is completely water cooled externally. There is no lining above the well, the walls consisting of vertical steel plate, 1-in. thick. Such a cupola may be classified and operated as acid, basic or neutral. Four 6-in. dia. water-cooled copper tuyeres project 10-in. beyond the lining. The height from the top of the tuyeres to the charging door is 26 ft. and just below the charging door is an expansion joint in the shell and immediately below this the water cooling starts.

Spray Cooling

The cooling system consists of a water spray through jets from a series of manifolds. Water pressure of 30 lb. per sq. in. is supplied from a 6-in. dia. main. Water from this spray runs down the outside of the shell and is collected in a weir. Evolution of steam is only in minor degree and presents no problem. The only refractory used is in the well. Carbon blocks were initially used here and were found to be satisfactory but expensive. A patching compound composed of clay and graphite was developed and found to be as effective as the carbon blocks and considerably cheaper. The situation eventually led to the fabrication and use of pressed blocks made from the clay-graphite mixture.

Operational Details

The cupola is front slagging and is continuously run into a forehearth from whence the metal is tapped into ladles. A radioactive actuated control has been installed as a stack-line indicator; this automatically cuts out charging at the upper limit and cuts off blast at the lower limit of the stack line. Operation of the cupola consists of automatic charging with a skip bucket using 2-ton charges, a coke ratio of 5:1 being maintained. Melting control is best when operation is extremely acid or extremely basic; at the neutral stage, the addition flux becomes critical. Due to the requirements for iron at the Ford Motor Company's plant their operation is neutral or slightly acid; no fluorspar is added and limestone is kept to a minimum.

The first iron down normally is high in carbon and this is adjusted by the addition of sand; metal temperatures at the spout are 1,500 deg. C. for the first metal down with the remainder of the melt at 1,490 deg. C. If hot-blast were available, then a finer control would be available to compensate for variables such as stack height, blast pressure, down time, initial melting, etc. To compensate for lack of hot-blast, oxygen enrichment is used, after a shutdown, to the extent of 2 per cent. of blast. Use of oxygen leads to higher carbon in the iron melted. High-quality coke is essential and Ford's find that 6-in. dia. is the optimum size. Although the plant has been found to be reasonably "foolproof," precautions must be taken; automatic systems are arranged to stop charging or cut off blast if the stack height goes out of control. Also, blast is automatically cut off if the water pressure drops from 30 to 20 lb. per sq. in.

The optimum period of operation before dropping the bottom has been found to be 200 hours. This does not include shutdown or holding time and normally amounted to 10 days' operation, with a production of 3,000 tons. Refractory consumption amounted to 12 per cent. of that of a normal cupola. The tap-hole consisted of magnesite and carbon and would normally erode from a starting diameter of 3 to 5 in. at the end of an operating period. Very little erosion takes place at the tuyeres. Four men can patch and repair the cupola in an 8-hour day, thus having it ready for another 200 hours of melting.

Mr. Dawson concluded by pointing out the advantages of the cupola, which are: Reduced refractory consumption, low maintenance and operational costs, and the additional control possible for the production of a wider variation of high-quality and high-strength irons.

Cupolas at Pontiac Motors*

At the plant of Pontiac Motors in Detroit, six cupolas of about 8 ft. 6 in. dia. each produce cast iron at a rate of 25-30 tons per hour. The shells of the cupolas are extended above the charging door level with the top few feet expanded to a diameter of 13 ft. In the expanded portion, a dome-shaped "umbrella," of $\frac{1}{4}$-in. steel, is suspended and kept irrigated by a flood of water. The dust-laden gases from the cupola striking this dome, are forced outwards so that they have to pass through a curtain of water falling from its periphery. The supply of water should be 290 gall. per minute but is, in fact, only 210. The water, together with deposited grit, passes away through an external pipe to a tank where the grit is swilled out, and the clarified water used again. Sulphur in the coke used is very low and no neutralizing agent has so far been thought necessary. Loss of dust to the atmosphere would doubtless be improved if a better supply of water were available.

* Extracted from "Air and Water Pollution—the position in Europe and in the United States." Published by the European Productivity Agency of the Organization for European Economic Co-operation, Paris; (price 18s.).

Company News

TUBE INVESTMENTS, LIMITED—An interim of 7½ per cent. has been declared on the company's £14,582,862 ordinary stock for the year to July 31, 1957, against 6¼ per cent. A final of 7½ per cent. was paid for 1956.

WORTHINGTON-SIMPSON, LIMITED, pump and pumping machinery manufacturers, of Newark (Notts)—The chairman, Sir Samuel Beale, announces that the Treasury has refused consent to the proposed one-for-two free scrip issue.

WESTINGHOUSE BRAKE & SIGNAL COMPANY, LIMITED—Approximately 98½ per cent. of the shares provisionally allotted in the recent rights issue were taken up. Few remained to satisfy the demand for excess shares; over 800,000 were applied for.

STOTHERT & PITT, LIMITED, engineers, ironfounders, etc., of Bath—As a result of an approach by Spencer (Melksham), Limited, discussions are taking place on the possibility of an association between the two companies whose products are to some extent complementary.

DAVY BRITISH OXYGEN, LIMITED—The company, the formation of which was reported in our issue of May 9 (p. 580), has now been established with a capital of £10,000. It is a joint interest of Davy & United Engineering Company, Limited, Sheffield, and the British Oxygen group for making available "oxy-steel" processes to the steel industry.

ROLLS-ROYCE, LIMITED—The company is to raise further capital of about £10,000,000 by a rights issue of new ordinary at 95s. per £1 share. Higher group profits, and an increase of 2½ per cent. to 20 per cent. in the 1956 dividend are announced, and Lord Kindersley, chairman, says that, barring unforeseen circumstances, the directors would expect to maintain that rate on the increased capital.

F. PERKINS, LIMITED, diesel-engine manufacturers, of Peterborough—The chairman, Mr. F. Perkins, has informed shareholders that the company still faces the prospect of a lower turnover in the current year compared with 1956. When he wrote his statement with the accounts, he explained, one of the additional orders he then mentioned was expected to augment materially the current year's turnover. Unfortunately, the initiation of deliveries against this order had been dropped back to the last quarter of the year.

NEWTON CHAMBERS & COMPANY, LIMITED—In his statement at the annual meeting Sir Peter Roberts, the chairman, said the heavy constructional department in the engineering division had achieved a record turnover. The much increased demand for capital equipment by the steel industry more than offset the loss of work due to the continued restrictions of expenditure in the nationalized industries, in particular the gas industry. In spite of the national decline in the demand for solid fuel appliances, the light castings department maintained its turnover at just below the 1955 level. Although the excavator division was affected by the credit squeeze and the Middle East disturbances, which adversely influenced the normal purchasing of both home and overseas customers, a full production programme was achieved. The expansion of business in overseas markets was particularly gratifying. The heavy constructional department had a satisfactory order-book and the range and type of work undertaken was being extended, assisted by an intensified programme of product development. Development work in the light castings department was continuing on new solid-fuel and oil-fired heating appliances.

Views on European Free Trade

Sir David Eccles, President of the Board of Trade, was the guest of honour at the Birmingham Chamber of Commerce banquet on May 13, and other distinguished guests included the eight ambassadors Mr. Y. A. Malik (USSR); Mr. P. T. Pereira (Portugal); Mr. Taleb Slin (Tunisia); Mr. Ivo Vejvoda (Jugoslavia); Mr. Hans von Herwath (Federal Republic of Germany); Mr. Ngo Dinh Luyen (Vietnam); Mr. Vittorio Zoppi (Italy); and Sayed Awad Satti (the Sudan). Representatives from Morocco, South Africa, and the USA were also present.

In urging that Britain accepted the challenge of the European Free Trade area with confidence, Sir David said that it must be ensured the rules of free trade were the rules of fair trade. He went on to say that to allow Western Europe to build up a single dynamic industrial area behind a tariff wall leaving the UK on the outside would be to forget one of the oldest principles of British policy, and it would be folly for us to sit with folded hands and watch the immense prizes of European integration being picked up by others. Our place was at the side of France and Germany working as partners. Naturally there was some hesitation about the effect of an open market in Europe on some businesses, but the Board of Trade was willing to discuss these difficulties.

Mr. J. E. Belliss, president of the Birmingham Chamber of Commerce, expressed the concern with which some industries viewed this "major step of liberalizing trade" but pointed out that the issue had to be considered on the broadest basis. Birmingham had always inclined to be protectionist and there were many in the city who did not see, in the same way as some of the larger industries did, the recent proposals against a background of automation and the desire for mass markets of a size comparable with those enjoyed by American manufacturers. However, despite these misgivings, he assured Sir David of Birmingham's support in the matter. He also mentioned that he thought it was vital that control should not be lost of the raw materials existing in the Commonwealth due to Britain's inability to supply the capital required for development. "It should be possible" he said "for the Commonwealth to find the capital within its own ranks, but, unfortunately, since the war this has not been so and about 87 per cent. of investment in Canada alone has come from America."

Contracts Open

The dates given are the latest on which tenders will be accepted. The addresses are those from which forms of tender may be obtained. Details of tenders with the reference ESB can be obtained from the Board of Trade Export Services Branch, Lacon House, Theobalds Road, London, W.C.1 (telephone: CHAncery 4411, ext. 738 or 771), unless otherwise stated.

INDIA, June 21—Twin-screw diesel fire floats and two pumps for the Bombay Port Trust. (ESB/10574/57.)

INDIA, June 17—Crushers, screens, hoppers and conveyors for the Coal Development Corporation. (ESB/11202/57.)

SOUTH AFRICA, June 6—Milling, shaping and drilling machines, tool grinders and cutters. (ESB/10502/57.)

KOREA, Zinc ingots for I.C.A. Procurement for Kuk Sung Industrial Company, Limited. (ESB/10977/57/ICA.)

AN EXTENSION of its transfer scholarships scheme is to be made by Imperial Chemical Industries, Limited, which is offering to provide three new scholarships to each of the universities of Bristol, Birmingham, and Sheffield. The new scholarships will be available for the academic year 1957-58.

News in Brief

THE BRITISH IRON & STEEL RESEARCH ASSOCIATION centre at Sheffield was visited by delegates to the 28th annual convention of the Yorkshire Council for Further Education, on May 10.

SHEFFIELD CHAMBER OF COMMERCE held its centenary annual meeting on May 15. It was attended by the Lord Mayor, Alderman Robert Neill, and the Master Cutler, Sir Peter Roberts, M.P.

Mr. FRANK A. HURST, managing director of Samuel Osborn & Company, Limited, Sheffield, will open the new sports centre and social club for the firm's 2,700 employees at Malin Bridge in June. The centre has cost about £15,000.

AN EXHIBITION to illustrate the scope and aims of the International Geophysical Year is now on view at the Science Museum (closing date October 31). The Museum is open on weekdays from 10 a.m. to 6 p.m. and on Sundays from 2.30 to 6 p.m.; admission is free.

FAIRFIELD SHIPBUILDING & ENGINEERING COMPANY, LIMITED, Glasgow, have entered into a licence agreement with Gebr. Stork & Company, N.V., Hengelo, Holland, for the construction of Stork single-acting two-stroke, turbo-charged marine-diesel engines for main propulsion.

THE FOUNDRY at the engineering works of Baker Perkins, Limited, Westwood Works, Peterborough, has returned to the normal five-day week, after having been on a four-day working week for over 3 months. The Suez crisis caused certain difficulties, in common with other firms.

Mr. C. E. HOLMSTROM, joint managing director of Firth-Vickers Stainless Steels, Limited, Sheffield, presented safe-driving awards to 13 of the firm's drivers on May 17. Mr. C. L. Oliver, holder of a 28-year safe driving record, received a bronze bar to a 25-year cross.

EDGAR ALLEN & COMPANY, LIMITED, Sheffield, have supplied a large number of cast manganese-steel pins, for use in coal elevators, to Horace Greaves & Company, Limited, Derby. It is claimed that the great advantage of these pins is their ability to withstand severe abrasion and wear.

YALE & TOWNE MANUFACTURING COMPANY, makers of materials handling equipment, are opening an extension to their Wednesfield, Staffs, factory on Thursday, June 6. Mr. Gilbert W. Chapman, president of the American company, is coming to Britain specially for the ceremony.

THERE were more than 1,000 employees at the first dance arranged for members of Newton Chambers & Company, Limited, Thorncliffe Works, at the Cutlers Hall, Sheffield on May 10. Among the guests were Mr. P. J. C. Bovill, managing director, and Alderman R. Neill, Lord Mayor of Sheffield.

WILLIAM BEARDMORE & COMPANY, LIMITED, Parkhead Forge, Glasgow, E.1, have had plans submitted to Glasgow Corporation for the erection of a furnace way, a two-bay covered scrap gantry, a high-level railway, and slag-breaking gantry, at Parkhead Steel Works, Duke Street, Glasgow, E.1.

RUSTON & HORNSBY, LIMITED, engineers, Lincoln, have built premises, at a cost of £300,000, equipped to carry out research and development work on the complete range of gas-turbines, locomotives, and other products, in connection with the use of nuclear energy as a source of power for turbine engines.

BRITISH OXYGEN GASES, LIMITED, are to build a new oxygen-compressing station at Mosley Road, Stretford, to meet the increased demands for the gas in the Manchester area. The building, which will include office facilities, will be erected by British Oxygen Engineering, Limited, and is expected to cost £43,000.

SHEFFIELD'S NEW OIL-FIRED HEATING INSTALLATION at the town hall was inspected by the Lord Mayor, Alderman Robert Neill, and members of the estates committee on May 15. It has been installed at a cost of £31,000, replacing obsolete plant condemned in 1950, and is a contribution towards a smokeless city centre.

BRITISH TRANSPORT WATERWAYS have placed a contract with Thames Launch Works, Limited, Twickenham, for the construction of six welded-steel butty boats for the South Eastern division. It is also proposed to purchase three diesel cranes for installations in crane boats on the River Trent and a hydraulic dredger for the Leeds and Liverpool Canal.

THE FACTORIES of George Kent, Limited, at Luton and London will be closed for the annual works holiday from Friday evening, July 19, to Tuesday morning, August 6. The Resolven & Hitchin factories close from Friday evening, July 26, to Monday morning, August 12. Certain offices at all factories will remain open and staffed during the holidays.

SPECIAL CASTINGS for use in a reducing furnace now being constructed by the British Aluminium Company, Limited, at Baiecumeau, Quebec, have been despatched by Lane & Girvan, Limited, Bonnybridge. The castings, intended to withstand abnormal periods of heating, presented considerable technical difficulties as the analysis called for brittle high-silicon iron.

THE MINISTER OF POWER, Lord Mills, opened a complete new office building at the Trafford Park Works of Lancashire Dynamo & Crypto Limited, on May 16. The occasion was marked by the attendance of more than 150 guests, including civic leaders, prominent local industrialists, representatives of nationalized industries and other official bodies.

A MEETING OF MEMBERS of the Midland area of the Association of Bronze and Brass Founders was held on May 21 at the Victoria Hotel, Wolverhampton. Following the meeting a film "Flow of Metals into Moulds" was shown. It was introduced by Mr. J. Hird, a member of the committee of the Institute of British Foundrymen, who were responsible for the film.

The detailed programme of the annual conference of the Institute of British Foundrymen was printed in the March 14 issue of this JOURNAL, and the works to be visited were described in the issue of May 2. There is now available from the Institute the conference handbook which as well as the technical programme gives details of the social events and places of interest to be visited.

FOR WRITING THE WORDS "Demonstration, Stanley Street, 10 a.m. Saturday" on the wall of Brown Bayley Steels, Limited, Sheffield, Mr. A. Laycock, an employee who was on strike at the time, was fined £1 in Sheffield on May 9. Sir Stuart Goodwin told him in court, "The penalty could have been £5. After all it takes a lot of rubbing out and these things can often be seen for years."

NEW PRODUCTS to be made at the extensions of the Newhouse (Lanarkshire) factory of Euclid (Great Britain) Limited, are crawler tractors, stated to be the largest size to be made in this country, and machines which can dig, transport and dump over 24 cub. yds. of earth at a time. Already this British-based American company export over 80 per cent. of their production, much of it earning dollars.

News in Brief

MR. MALIK, the Russian ambassador, speaking at a BIF luncheon on May 13, said that if restrictions and discriminations in trade were lifted, the Soviet Union would be able in the next five years to increase its imports from the United Kingdom by 9 to 11 billion roubles. The present state of trade between Russia and Britain was far from corresponding to the economic capacities of the two countries.

MR. MICHAEL CLAPHAM, joint managing director of the ICI metals division, was one of a panel of four at a "brains trust" on the Free Trade Plan, which the Birmingham Chamber of Commerce organized at the Town Hall, Birmingham, on May 16. He suggested that small firms should press their trade associations to form economic units; they should also tackle markets in countries of which they were most afraid.

LORD HIVES, former executive chairman of Rolls-Royce, Limited, will lay the foundation stone of Derby's new College of Art and Technology, on July 5. The foundation stone, which will be laid on a triangular table of concrete supported on three legs in the forecourt of the new college, symbolizes the three aspects of education—body, mind and spirit. The first instalment of the college has cost nearly £450,000.

THREE BROTHERS, employed by the English Steel Corporation Limited, Sheffield, have a record of 107 years of service with the firm. Mr. Joseph and Mr. Leonard Jordan in the fuel engineering department, have 37 and 34 years' service respectively, and Mr. Hector Jordan, in the ingot planning shop, has 36 years. Their father, Mr. Edward Jordan, was in the steam service department for 30 years, until his death in 1938.

UNITED STEEL COMPANIES, LIMITED, Sheffield, are setting up an industrial-hygiene section at the suggestion of medical officers at the various branches. The section will be based at the Swinden laboratories at Rotherham, and will conduct research into the problem of airborne contamination. It will also carry out routine air sampling in connection with processes known to be hazardous, such as making and processing leaded steel.

DAVID BROWN INDUSTRIES, LIMITED, tractor division, have taken twice as much space as last year at the Poznan Fair—which opens on June 9—because of the increasing importance of Poland as a potentially valuable export market. They are exhibiting a full range of wheeled and crawler tractors, including the new 40 h.p. "900" wheeled tractor and modified 50 TD crawler, both of which will be seen in Poland for the first time.

IT IS REPORTED that Universal Educational Films (producers, importers and distributors of educational and information films), Post Box No. 567, New Delhi, wish to extend their range of British technical films for display at various technical centres throughout India. The organization is of some repute and is the sole distributor for UNESCO films in India. Those interested should write to the director, Mr. L. C. Bhasin, for further details.

A GOLF MEETING has been arranged by the Non-Ferrous Club, to take place on Wednesday, June 26, at the Stratford-on-Avon Golf Club. A Stapleford competition will be held in the morning and a Greensome foursome in the afternoon; prizes will be competed for on both occasions. Full details of the meeting, which will be open to all golfers connected with the metal industry, may be obtained from Mr. T. B. Taylor, 115, Charles Henry Street, Birmingham, 12.

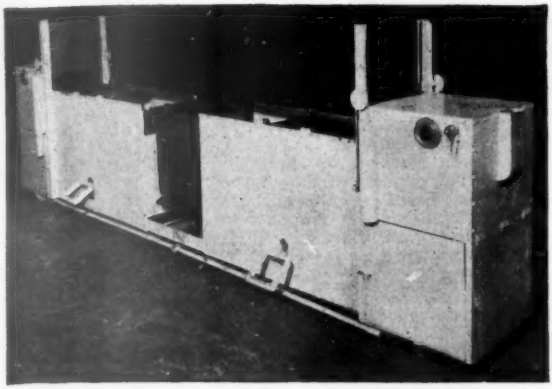
THE FESTIVAL of "Films in the Service of Industry" is to be held in Harrogate, October 8 to 12, under the presidency of Lord Godber. Producers of industrial films have been approached to submit films for consideration by selection panels, for competitive exhibition at the festival. For the first year the competition is confined to films produced in this country. Application forms and other details can be had from the organizing secretary of the festival at 3, Portman Chambers, 7/9, Baker Street, London, W.1.

WHEN MR. JOHN HAY WHITNEY, the United States Ambassador, visited the British Industries Fair on May 16, he was presented with a cigarette box which is a replica of the chests now being carried to America in Mayflower II. The presentation was made by Mr. J. E. Belliss, president of the Birmingham Chamber of Commerce. Mr. Whitney said that the United States had become Britain's greatest customer for the first time in history. "It takes energy, skill, and imagination to penetrate the American market" he said "but the rewards are great."

IT IS ANNOUNCED that the contract for the dismantling and removal of the well-known Liverpool overhead railway has been awarded to George Cohen Sons & Company, Limited, one of the 600 Group of Companies. Opened in 1893 the railway runs parallel with the docks from Seaforth in the North, to Dingle in the South, an overall distance of more than six miles. Taking into account the vast amount of material to be dismantled and the many complexities involved, George Cohen's have been allowed up to two years in which to complete the contract. It is understood that there are more than 25,000 tons of ferrous metal involved.

MR. IVAN SHORTT, introduced as "one of the greatest authorities in the world on old Sheffield plate and antique silver," was the guest speaker at a meeting of the Midlands branch of the Gemmological Association of Great Britain, on May 10. He spoke on "Antique and Modern Silver and Plate," and expressed the view that the Matthew Boulton collection of plate and silver in the possession of Birmingham, was the finest in existence. He said *inter alia* that in the 18th century there were 45 assay officers compared with six to-day, and that 1829 was accepted as the demarcation line for differentiating between antique and modern silver and plate. He pointed out that every part of every piece of antique silver is marked with the four marks of the assay system, and illustrated this with two fake pieces where one unmarked part had been substituted.

AT THE OFFICIAL LUNCHEON at the British Industries Fair on May 10, Sir Hugh Beaver, president of the Federated British Industries, congratulated the Birmingham Chamber of Commerce on its "courageous and enterprising effort" in carrying on the Fair alone. Sir Hugh hinted that the BIF might become an international show, although how where and when he could not say. Mr. J. E. Belliss, president of the Birmingham Chamber, reported a sharp upward swing in the numbers of foreign buyers—an increase of 51 per cent. compared with the first four days of the Fair last year. An increase, though less marked, had been recorded among home buyers. Viscount Davidson, president of the Engineering Industries Association, thought great difficulties would be encountered if the proposed European Free Trade scheme came into operation, and Britain did not follow the continental pattern of a world fair. "It may well be that sooner or later the BIF will have to develop on to a very much broader basis," he said. He advised exhibitors to pay special attention to Latin American markets, especially in Brazil.



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Thermostatic temperature control gives maximum efficiency with minimum running costs.

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Personal

Mr. C. J. S. BARFORD has been appointed a director of Aveling-Barford, Limited.

Mr. P. HOPKINSON, managing director of British Furnaces, Limited, Chesterfield, is on a business trip to Australia, and will be away for about four months.

Mr. D. H. PARKINSON, a director of Parkinson and Spencer, Limited, Ambler Thorn, manufacturers of refractory materials, has been appointed a magistrate for the West Riding of Yorkshire.

Mr. BRIAN BROMWICH has been appointed chief Press officer of the General Electric Company, Limited, in succession to Mr. D. C. ROGERSON, who has been appointed deputy publicity manager (engineering).

Mr. P. J. CLYNES, a furnaceman in the heat-treatment department of William Jessop & Sons, Limited, Brightside, Sheffield, retired on May 17 after 24 years with the firm. He was presented with an electric clock.

Mr. L. H. HORNSBY, C.B.E., Director of Public Relations, Ministry of Labour and National Service, is leaving the Ministry on June 30 to take up a commercial appointment. A successor has not yet been appointed.

Mr. S. K. PRESTIGE has been appointed chairman of the Coleman-Wallwork Company, Limited, with effect from April 1. Mr. E. KENT remains managing director, and the following have been appointed directors:—Mr. W. L. JACKSON, Mr. J. A. HUFTON, and Mr. G. V. EAST.

Mr. R. WILLIAMS, who has been associated with the Caterpillar Tractor Company, of Desford, Leicestershire, since 1951, has been appointed inspector manager at the company's Glasgow headquarters. His successor as quality-control manager at Desford, is Mr. R. SMITH.

Mr. ARNOLD W. LEE has been appointed managing director of the Norton Wheel Grinding Company, Limited, Welwyn Garden City. He succeeds Mr. John C. Ewer who is leaving to take up a new appointment with the Norton Company, USA. Mr. Lee has been a director of the company since 1952.

Mr. RICHARD TATCHNER, who since 1950 has been with F. Perkins, Limited, diesel engine manufacturers, of Peterborough, and for the past five years has been supervisor of the export department, has been appointed acting European zone manager in the company's export department. He succeeds Mr. A. ALLES, who has taken a post outside the company.

Mr. A. S. DODD has been appointed a director of John Thompson Water Tube Boilers, Limited, and London manager of John Thompson, Limited. In London he succeeds Mr. C. J. HOWARD, who was recently appointed managing director of the former firm. At John Thompson, Limited, Belfast, Mr. JAMES BOYD has been appointed area manager to the group.

The South Wales territory of Foundry Services, Limited, has been taken over by Mr. ARTHUR CECIL THOMAS, with headquarters at Rogerstone, Monmouthshire. Mr. Thomas was appointed manager of the Foseco experimental and research foundry at Nechells, Birmingham in 1943, and has for many years represented the company in the East Coast and London areas.

Mr. R. L. RICHARDS has been appointed the first manager of the newly formed Standards Association of the Federation of Rhodesia and Nyasaland. Mr. Richards, who is 39 and a senior technical officer of the British Standards Institution, is an Australian. A metallurgical engineer, he worked for the Australian Standards Association from 1944 to 1947. With the BSI he has been chiefly concerned with standards for metals and welding.

The following appointments have been announced by Air Control Installations, Limited, Ruislip, Middlesex. Mr. G. E. CLIFFORD, B.SC., has been appointed technical director, and Mr. H. C. S. BRAND, M.A., has been made works director. Mr. Clifford has been chief engineer of the company since 1936 and joined the board as alternate director in October 1955. Mr. Brand for the past six years has been works director at Addis, Limited.

Mr. H. BALL and Mr. G. LONGDEN of Stanley Works (G.B.) Limited, hand-tool manufacturers, Sheffield, have left for a nine-week visit in the United States, where they are visiting the Atha and New Jersey Plants of Stanley Tools to study hammer production. They have both been appointed to posts at the new Stanley hammer factory, to be opened near Sheffield later this year. Mr. Ball is plant foreman supervising forging and die-stamping, and Mr. Longden is a development engineer at the new factory.

Sir DOUGLAS BRANSON, a director of Newton, Chambers & Company, Limited, and Mr. JOHN HADFIELD, chairman and managing director of Derbyshire Stone, Limited, and a director of many other companies, have been appointed members of the Sheffield local board of the National Provincial Bank, Limited. Mr. GERALD STEEL, managing director of the United Steel Companies, Limited, chairman of Samuel Fox & Company, Limited, and a director of the Hoffman Manufacturing Company, Limited, and other companies, has resigned from the board, but remains a director.

Sir HAROLD GILLETT, whose many business appointments include the chairmanship of Betts & Company, Limited, manufacturers of metallic capsules, etc., of London, N.19, has been re-elected chairman of the London Chamber of Commerce. Re-elected to the office of deputy chairman is Mr. ALLEN L. STOCK, who is managing director of the Morgan Crucible Company, Limited, and chairman of the Ship Carbon Company of Great Britain, Limited, and Lodge Plugs, Limited. The treasurer, Mr. RICHARD L. J. WILLS, who has been re-elected to office, is a member of the export panel of the British Standards Institution and a member of the council of the Association of British Chambers of Commerce.

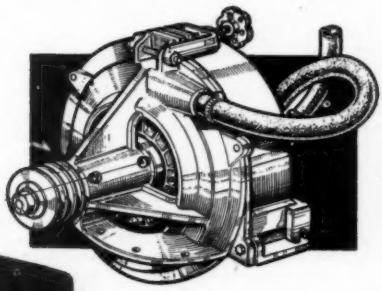
Obituary

Mr. W. D. SANGWIN, managing director and deputy chairman of Tarslag Limited, civil engineering and building contractors, of Stockton, Wolverhampton and Rotherham, died on May 12 at the age of 47. Mr. Sangwin was a member of the Worshipful Order of Paviors and a Freeman of the City of London. He was chairman of the North-Eastern section of the Federation of Civil Engineering Contractors from 1952 to 1956.

The death is announced of Dr. GEOFFREY EDWIN FOXWELL, C.B.E., hon. secretary and a past-president of the Institute of Fuel. During the last war Dr. Foxwell was technical adviser to the Ministry of Fuel and Power and also a member of the Ministry's Education Committee. Since 1954, he had been a member of its Fuel Efficiency Committee, and he was also a member of Sir Hugh Beaver's committee on air pollution. His doctorate thesis on the "Plastic State of Coal," has become part of the authoritative literature of the science of fuel technology.

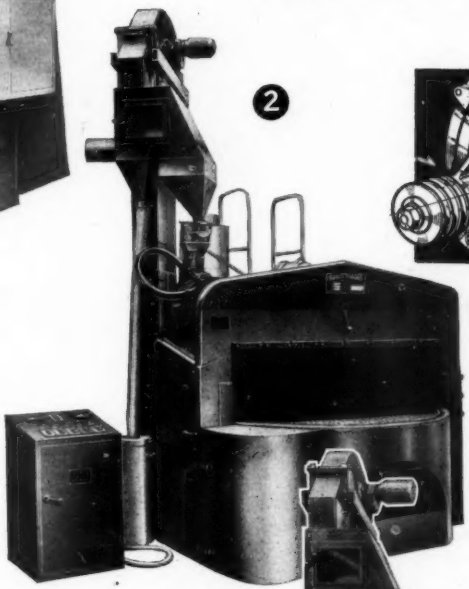
Shot Blast Equipment

This A-S-L Turbine is the most modern Shot Blasting Unit available. The bi-phase air injection system enables shot to be projected at greater speeds using lower power with fewer replacements. The economies effected in spare parts alone are very substantial.



Baker Perkins High Speed Bi-Phase A-S-L Turbine, British Patent, No. 510681.

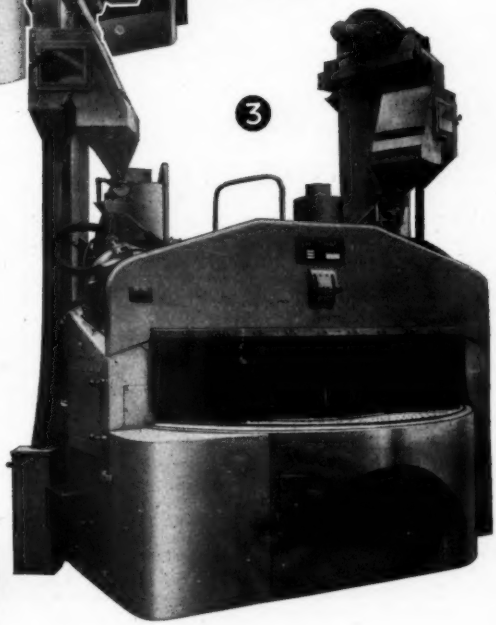
These machines do not require pits or special foundations.



1 ROTARY BARREL

2 CADET

3 MEDIUM



Our standard range of Rotating Barrel and Table Shot Blast Machines is capable of handling a wide range of Foundry products. Both types are semi-automatic, the rotating barrels being equipped with skip hoist loading gear and frontal discharge mechanism. These modern highly efficient machines are in use in Foundries all over the world, and are built to the high standards of design, materials and workmanship characteristic of all Baker Perkins' machines.

BAKER PERKINS LIMITED
ENGINEERS
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Raw Material Markets

Iron and Steel

Outputs of pig-iron continue to be maintained and plentiful supplies of raw materials are available to ensure continuous operation. Deliveries of ore from both home sources and abroad are satisfactory in quantity for consumption and stock requirements, although the qualities are not always in proportion to the needs of the furnaces, particularly in the low-phosphorus grades. This on occasions is the cause of concern to makers of low-phosphorus pig-iron and hematite. Supplies of blast-furnace coke have been and continue to be on a much better scale than was anticipated and increased coke-oven capacity and the improved coal supply position ensure good deliveries in future.

The steelworks continue to be the largest users of pig-iron and readily accept over three quarters of total output. This is generally sufficient for present needs, although some areas appear to be better off for supplies than others. Consignments of imported iron continue to come to hand, but the steelworks are not so dependent on these deliveries as they were a short time ago. In so far as future demands of pig-iron are concerned, the steelworks will continue to absorb all available supplies of basic pig-iron, and present tonnages will have to be stepped up to provide sufficient supplies for the larger outputs of ingot steel which are scheduled for the future. It is, therefore, expected that the furnaces now supplying basic steelmaking pig-iron will continue to be burdened for this grade, and supplies from these units will be augmented from new furnaces which will be brought in later.

For the foundry irons, demands for which have for some time been on a subdued scale, the chief requirements are likely to continue for the low-phosphorus pig-irons and hematite. High-duty castings for many trades are in good demand, and with the expanding markets in the motor-car industry, increased outputs of castings are being called for. Makers of the low-phosphorus irons are able to dispose of most of their makes, and the comparatively small stocks which they hold are likely to be disposed of in the near future. With the demands from the foundries and steelworks hematite makers can generally find a home for their production. Refined irons can be obtained without much difficulty.

Demands show little change for the high-phosphorus irons, and although outputs continue on a reduced scale owing to the prior claims of the steelworks for basic pig-iron, the light, jobbing, and textile foundries and other users of this grade are amply provided with their needs. Foundry coke deliveries are satisfactory, and ganister, limestone, and firebricks are obtained to requirements. The foundries also appear to have adequate supplies of scrap.

Many of the re-rollers are well provided with steel semis. With the improved supplies from home steelworks, consignments have also recently come to hand from abroad, and for some sizes and qualities they have adequate stocks. Chief call from home suppliers is for small 2-in. billets and special quality steels.

The work on hand is enabling the re-rollers to obtain fairly good outputs of small bars and light sections for which improved deliveries are now offered due to the reduced pressure in demands. Strip re-rollers are a little more busy on account of the improved requirements of the motor vehicle trade, and for reinforcing rods there is a big demand. The re-rollers have some export business on hand, and could undertake additional orders if licences could be obtained.

Non-ferrous Metals

A sharp rise in the stocks of refined copper in London Metal Exchange official warehouses last week raised the total 1,675 tons to 6,972 tons. This steep increase accentuated the downward drift in the metal and on Monday it had fallen to its lowest level since August, 1954, and the backwardation was replaced by a small contango. Nevertheless, there has been fair activity in the market and the feeling is that the fall may be overdone and thus a technical rally soon may set in. In the United States the position remains unchanged; business is modest. The producers are maintaining their price at 32 cents, but custom smelters are selling at 30 cents at which level trading has been resonably good. Copper for export is exchanging hands around, but often below, 30 cents a pound with the scrap quotation wavering around 24 to 24½ cents.

Zinc, after its 2 cent per pound fall in the last fortnight, continues to be susceptible to any rumours and reports concerning stockpiling. Plans for future stockpiling are not yet clear, but the Director of Defence Mobilization last weekend said that the US Government would increase its domestic purchases of lead and zinc for the strategic stockpile in June. The reason for the increase, he said, was to allow the Government to take advantage of the lower market price and a call for June purchases would be issued by the General Services Administration some time this week. This was interpreted bullishly in London and the price recovered slightly, although the price is still well down from its level two weeks ago.

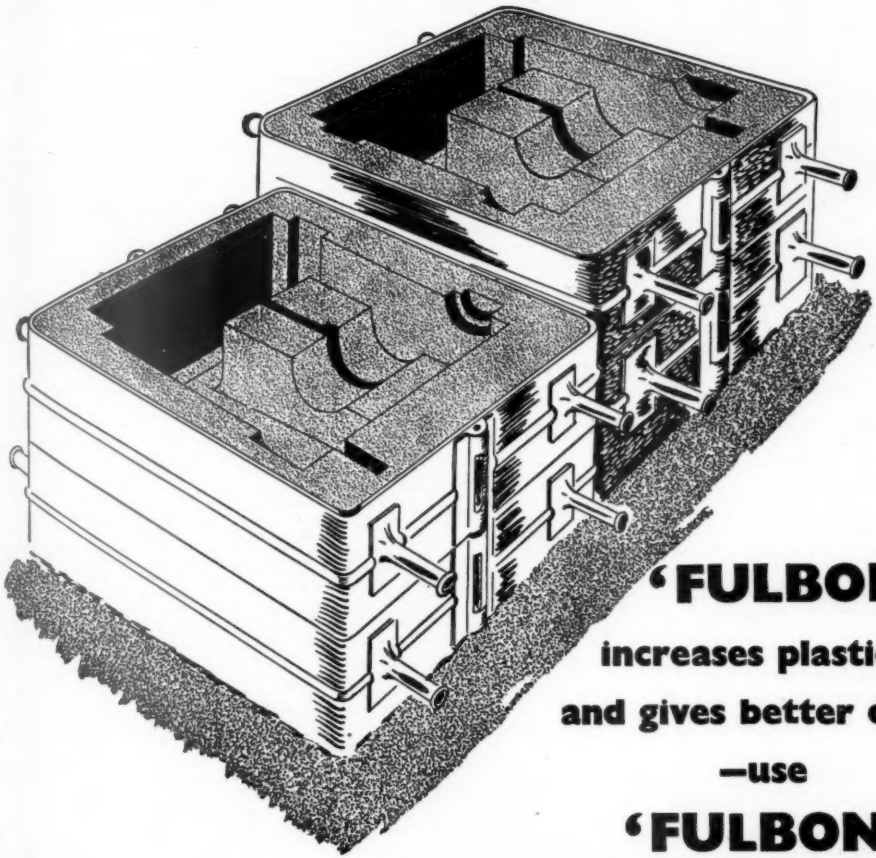
Lead, which has only fallen ¼ cent a pound in the US during the past fortnight staged a mild rally on the news that increased lead would be purchased next month for the strategic stockpile. At the same time business was poor, but there is no great selling pressure. The US price is steady at 15¼ cents per pound.

Tin remains quietly steady. Consumer off-take is good and, although stocks are rising in LME official warehouses, the small backwardation persists. In spite of the difficult political conditions attaining in Indonesia the fall in the shipments of concentrates, though fairly large, are not as great as many believed they would be.

K & L "Open Day"

On Thursday of last week, K. & L. Steelfounders and Engineers, Limited, were hosts at Letchworth to about 130 guests comprising representatives of customer firms, overseas buying authorities, the technical Press, inspection bodies and employer associations. Before and after an excellent luncheon, provided by the firm, the party was split into small groups for touring the various departments of the works, accompanied by knowledgeable guides drawn from the staff. Of major interest to the party was a new foundry extension just completed for the manufacture of the lighter range of steel castings undertaken by K. & L. This and the recently opened ablution block for foundry employees came in for much praise—many of the touring parties were quite unaware of the progress made in foundry amenities in recent years. Pride of place amongst the firm's products on show was the new Jones KL10—mobile crane—a fast-travel model of lifting capacity of 10 tons at 10-ft. radius with a 30 ft. jib mounted on a four- or six-wheel road vehicle chassis, and using the same engine for hoisting and driving. The whole proceedings were conducted in a friendly and informal atmosphere indicative of the cordial relations which the firm enjoys with its clientele.

DEEP DRAWS...



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CW18

Current Prices of Iron, Steel, and Non-ferrous Metals

(Delivered unless otherwise stated)

May 22, 1957

PIG-IRON

Foundry Iron.—No. 3 IRON, CLASS 2:—Middlesbrough, £20 1s. 0d.; Birmingham, £19 13s. 3d.

Low-phosphorus Iron.—Over 0.10 to 0.75 per cent. P, £21 18s. 0d., delivered Birmingham. Staffordshire blast-furnace low-phosphorus foundry iron (0.10 to 0.50 per cent. P, up to 3 per cent. Si), d/d within 60 miles of Stafford, £22 2s. 3d.

Scotch Iron.—No. 3 foundry, £23 4s. 6d., d/d Grangemouth.

Cylinder and Refined Irons.—North Zone, £24 6s. 6d.; South Zone, £24 9s. 0d.

Refined Malleable.—P, 0.10 per cent. MAX.—North Zone, £25 14s. 0d.; South Zone, £25 16s. 6d.

Hematite.—Si up to 2 per cent., S. & P. over 0.03 to 0.05 per cent.:—N.-E. of England (local iron), £22 17s. 6d.; Scotland (Scotch iron), Zone S. 1, £23 4s. 0d.; Sheffield, £24 4s. 6d.; Birmingham, £24 12s. 0d.; Wales (Welsh iron), £22 17s. 6d.

Basic Pig-iron.—£19 3s. 0d. all districts.

FERRO-ALLOYS

(Per ton unless otherwise stated, delivered)

Ferro-silicon (6-ton lots and over).—45 per cent. Si, £50 0s. 0d. to £53 5s. 0d., scale 17s. 0d. to 17s. 6d. per unit; 75 per cent. Si, £70 0s. 0d. to £76 7s. 6d., scale 17s. 0d. to 17s. 6d. per unit.

Ferro-vanadium.—50/60 per cent., 28s. 6d. per lb. of V.

Ferro-molybdenum.—65/75 per cent., carbon-free, 12s. 3d. per lb. of Mo.

Ferro-titanium.—20/25 per cent., carbon-free, £260 0s. 0d.; 38/40 per cent., £299 0s. 0d.

Ferro-tungsten.—80/85 per cent., 11s. 9d. per lb. of W.

Tungsten Metal Powder.—98/99 per cent., 14s. 9d. per lb. of W.

Ferro-chrome (6-10 ton lots).—4/6 per cent. C, £96 0s.0d. to £99 10s. 0d., basis 60 per cent. Cr, scale 33s. 0d. per unit; over 6 per cent. C, £94 0s. 0d., basis 60 per cent. Cr, scale 31s. 0d. to 33s. 0d. per unit; 2 per cent. C,* 2s. 2d. per lb. Cr.; 1 per cent. C,* 2s. 2½d. per lb. Cr; 0.15 per cent. C,* 2s. 3d. to 2s. 3½d. per lb. Cr; 0.10 per cent. C,* 2s. 3½d. to 2s. 3¾d. per lb. Cr; 0.06 per cent. C,* 2s. 3¾d. to 2s. 4d. per lb. Cr.

Metallic Chromium.—98/99 per cent., 7s. 0d. to 7s. 6d. per lb.

Metallic Manganese.—90/92 per cent., carbon-free, £290 0s. 0d.; 96/98 per cent., £310 0s. 0d.

Ferro-columbium.—65/75 per cent. Nb + Ta, 22s. 0d. to 23s. 0d. per lb., Nb + Ta.

Ferro-manganese (home).—78 per cent., £82 12s. 6d.

SEMI-FINISHED STEEL

Re-rolling Billets, Blooms, and Slabs.—BASIC: Soft, u.t., £30 9s. 0d.; tested, 0.08 to 0.25 per cent. C, £31 9s. 0d.; hard (0.41 to 0.60 per cent. C), £32 10s. 6d.; silico-manganese, £41 0s. 0d.; free-cutting, £34 13s. 0d. SIEMENS MARTIN ACID: Up to 0.25 per cent. C, £38 4s. 6d.; silico-manganese, £41 7s. 6d.

Billets, Blooms, and Slabs for Forging and Stamping.—Basic, soft, up to 0.25 per cent. C, £36 3s. 6d.; basic, hard, over 0.41 up to 0.60 per cent. C, £37 6s. 0d.; acid, up to 0.25 per cent. C, £40 7s. 6d.

FINISHED STEEL

Heavy Plates and Sections.—Ship plates (N.-E. Coast), £39 2s. 0d.; boiler plates (N.-E. Coast), £41 12s. 0d.; floor plates (N.-E. Coast), £40 11s. 0d.; sectional material, N.-E. Coast, £37 11s. 6d.

Small Bars, Sheets, etc.—Rounds and squares, under 3 in., untested (4-ton lots), £37 18s. 0d.; flats, 5 in. wide and under (4-ton lots), £37 18s. 0d.; hoop and strip, £37 17s. 6d.; uncoated strip mill coils, hot rolled, under 3mm. to 12g., £41 6s. 0d.; black sheets (hand mill), 17/20 g., £52 4s. 6d.; galvanized corrugated sheets, 24 g., £65 9s. 0d.

Alloy Steel Bars.—1 in. dia. and up: Nickel, £65 10s. 3d. nickel-chrome, £92 13s. 0d.; nickel-chrome-molybdenum: £104 11s. 6d.

NON-FERROUS METALS

Copper.—Cash, £239 15s. 0d. to £240 0s. 0d.; three months, £240 10s. 0d. to £241 0s. 0d.; settlement, £241 0s. 0d.

Copper Tubes, etc.—Solid-drawn tubes, 2s. 3½d. per lb.; rods, 267s. 3d. per cwt. basis; 20 s.w.g., 300s. 6d. per cwt.

Tin.—Cash, £765 0s. 0d. to £765 10s. 0d.; three months, £762 0s. 0d. to £762 10s. 0d.; settlement, £765 10s. 0d.

Lead (Refined Pig).—Second half May, £99 10s. 0d. to £99 15s. 0d.; second half August, £99 10s. 0d. to £100 0s. 0d.

Zinc.—Second half May, £88 0s. 0d. to £89 0s. 0d.; second half August, £84 15s. 0d. to £85 5s. 0d.

Zinc Sheets, etc.—Sheets, 15g. and thicker, all English destinations, £118 10s. 0d.; rolled zinc (boiler plates), all English destinations, £116 5s. 0d.; zinc oxide (Red Seal), d/d buyers' premises, £99.

Brass Tubes, etc.—Solid-drawn tubes, 1s. 10½d. per lb.; rods, drawn, 2s. 11d.; sheets to 10 w.g., 200s. 9d. per cwt.; wire, 2s. 7⅛d.; rolled metal, 200s. 9d. per cwt.

Brass (Brazing).—BS1400, B3 (65/35), £169; B6 (85/15), £231; BS249, —.

Brass (High Tensile).—BS1400, HTB1 (30 tons), £224; HTB2 (38 tons), —; HTB3 (48 tons), £258.

Gunmetal.—BS1400, LG2 (85/5/5/5), £266; LG3 (86/7/5/2), £238; G1 (88/10/2/½), £288; (88/10/2/1), £270.

Phosphor Bronze.—BS1400, PB1 (AID released), £300 per ton.

Phosphor Bronze Strip, etc.—Strip, 287s. 0d. per cwt.; sheets to 10 w.g., 290s. 0d. per cwt.; wire, 3s. 11⅛d. per lb.; rods, 3s.3⅛d.; tubes, 3s. 3⅛d.; chill cast bars: solids 3s. 3½d., cored 3s. 4½d. (CHARLES CLIFFORD, LIMITED.)

Nickel Silver, etc.—Rolled metal, 3 in. to 9 in. wide × 0.056, 3s. 10d. per lb.; round wire, 10g. in coils (10 per cent.), 4s. 2⅛d.; special quality turning rod, 10 per cent., ½ in. dia., in straight lengths, 4s. 1⅛d. All prices are net.

Other Metals.—Magnesium, ingots, 2s. 5½d. per lb. Antimony, English, 99 per cent., £210 0s. 0d. Quicksilver, ex-warehouse, £83 0s. 0d. Nickel, £600 0s. 0d. Aluminium ingots, £197 0s. 0d.; aluminium bronze (BS1400), AB1, £260; AB2, £275.

* Average 68-70 per cent.